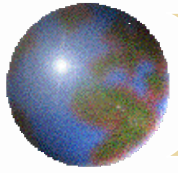


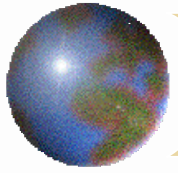
# *Impact of AIRS data on analyses and forecasts at NASA/GSFC*

R. Atlas and J. Joiner  
Laboratory for Atmospheres



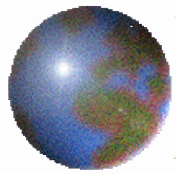
# *Background*

- ✿ At GSFC we are evaluating the impact of AIRS data in several different forms,
  - ✦ AIRS Team physical retrievals
  - ✦ 1D VAR interactive retrievals
  - ✦ AIRS radiances
- ✿ The impact of clear retrievals or radiances vs the addition of partially cloudy data is being evaluated.
- ✿ The impact of data over water vs data over both water and land is being evaluated.
- ✿ The impact of AIRS is being evaluated using several different DAS: FVDAS, FVSSI, EDAS



## *Metrics for Assessing the Impact of AIRS*

- ✦ O-F statistics to evaluate very short range forecast improvement.
- ✦ Anomaly Correlations and RMS errors computed for sea level pressure, geopotential height, and additional primary and derived quantities to evaluate the impact on short to medium range (1-10 day) forecasting.
- ✦ Precipitation Threat Scores to evaluate the impact of AIRS on short to extended range forecasts of precipitation.
- ✦ Objective statistics for specific meteorological phenomena: eg. cyclone locations and tracks, cyclogenesis, cyclolysis, cyclone intensity, significant weather associated with storms (such as damaging winds, heavy snow, etc). Statistics will be generated over all cases of the phenomena as well as being stratified according to intensity.
- ✦ Case Studies of significant weather events: Specific cases of significant weather will be identified. In each case of forecast impact the impact on the initial conditions for the forecast and the growth of the prognostic impact will be determined.



## *Initial AIRS Experiments WITH FVSSI*

### GLOBAL DATA ASSIMILATION SYSTEM USED:

fvSSI: fvGCM - Resolution: 1x1.25

SSI (NCEP) analysis-T62

**PERIOD OF ASSIMILATION:** 1 January - 31 January, 2003

### EXPERIMENTS:

CONTROL: All Conventional Data + ATOVS + Radiance (NOAA-14, 15, 16)  
+ CTW + SSM/I TPW+ SSM/I Wind Speed + QuikScat + Ozone

CONTROL + AIRS (Clear/Ocean / -40 - + 40 deg)

CONTROL + AIRS (Clear/Ocean/Global)

CONTROL + AIRS (Clear +Partly Cloudy/Ocean/Global)

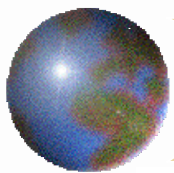
CONTROL + AIRS (Clear +Partly Cloudy/Ocean/Global – no sea ice, EC check)

CONTROL + AIRS (All/Ocean/Global) – cloud cover up to 80%

CONTROL + AIRS (Clear +Partly Cloudy/Ocean&Land/Global)

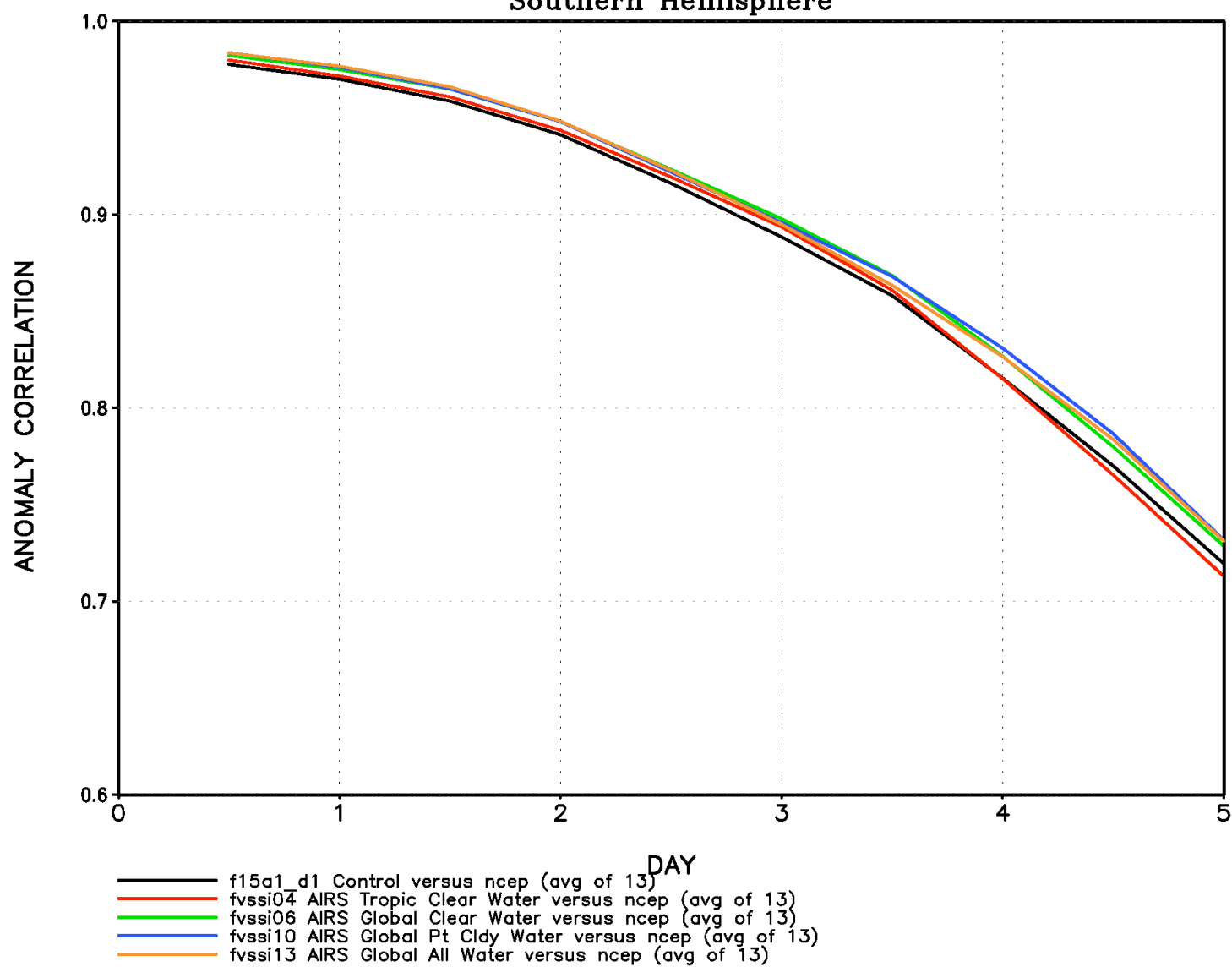
**FORECASTS:** 13 forecasts run every two days beginning on 6 January, 2003

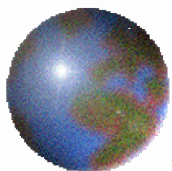




## 500 MB GEOPOTENTIAL HEIGHTS

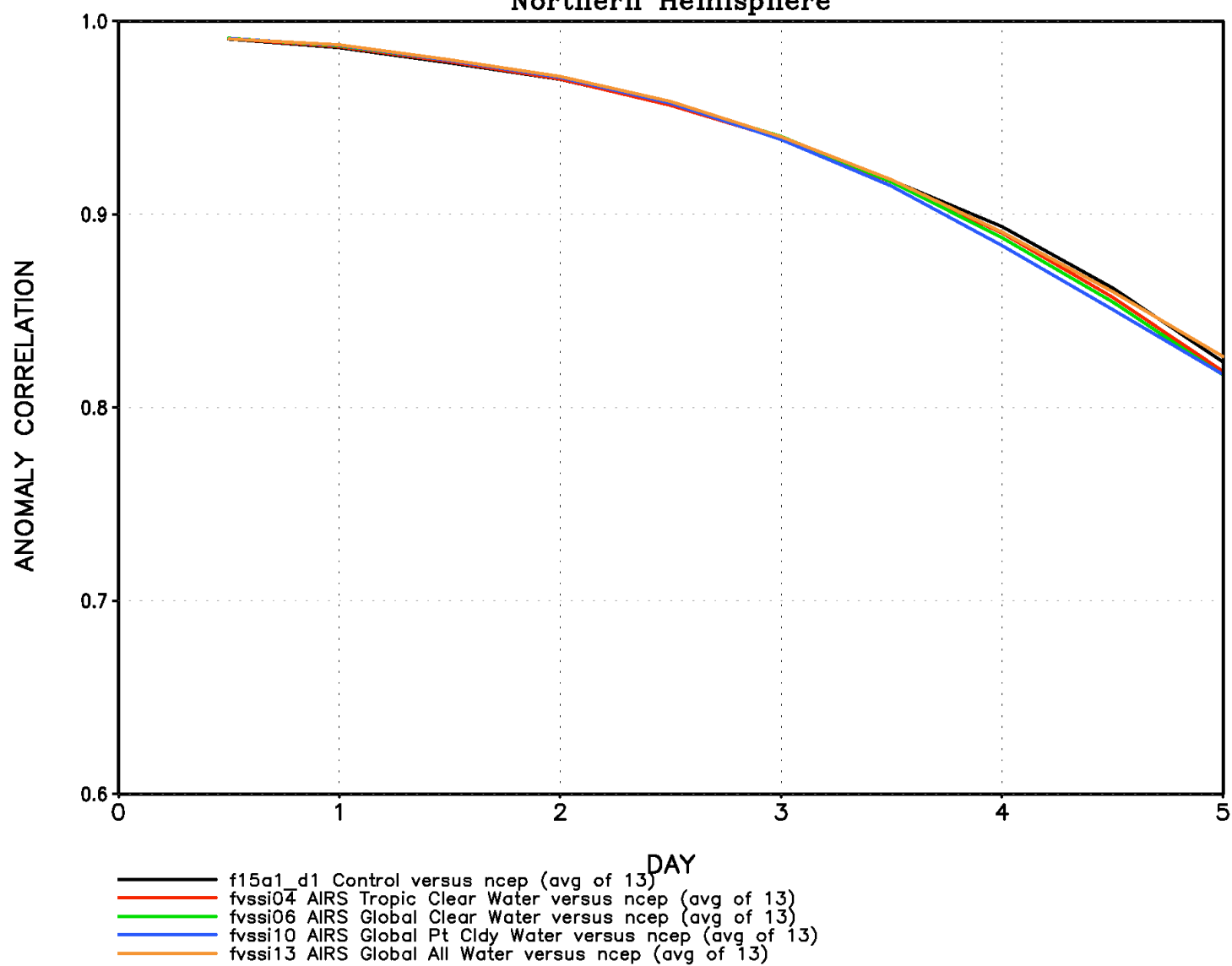
Southern Hemisphere





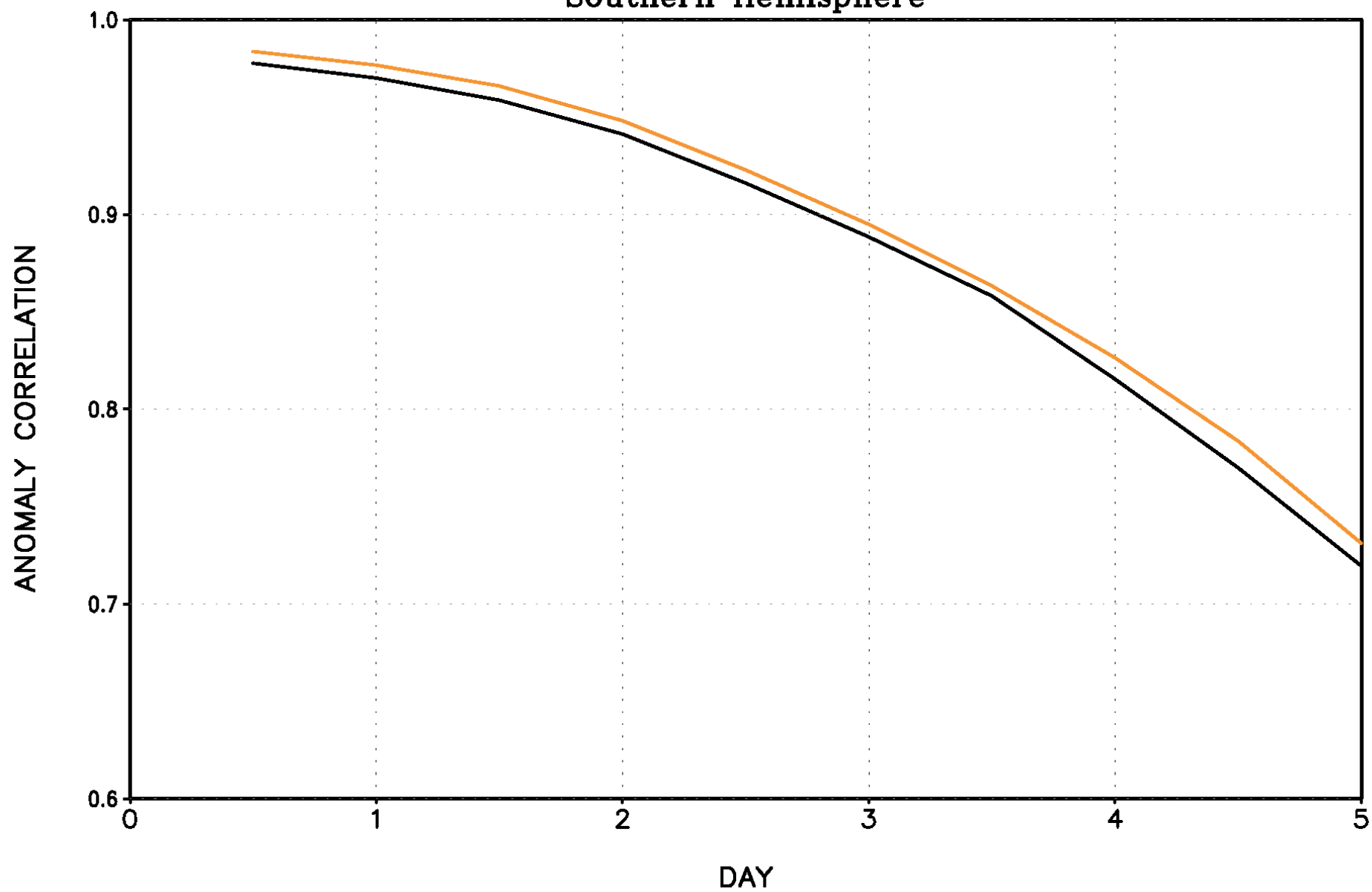
## 500 MB GEOPOTENTIAL HEIGHTS

Northern Hemisphere



# 500 MB GEOPOTENTIAL HEIGHTS

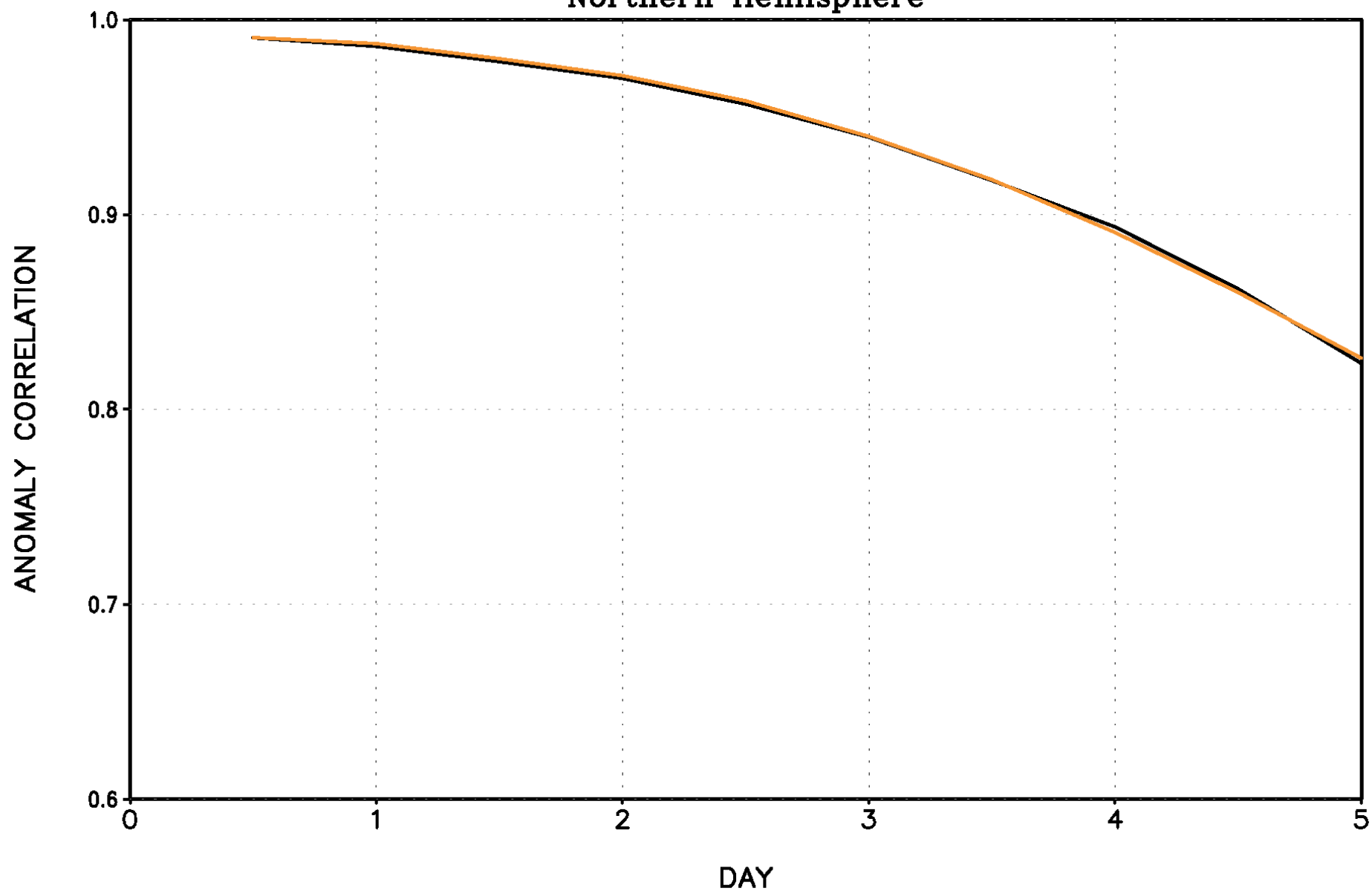
Southern Hemisphere



f15a1\_d1 Control versus ncep (avg of 13)  
fvssi13 AIRS Global All Water versus ncep (avg of 13)

# 500 MB GEOPOTENTIAL HEIGHTS

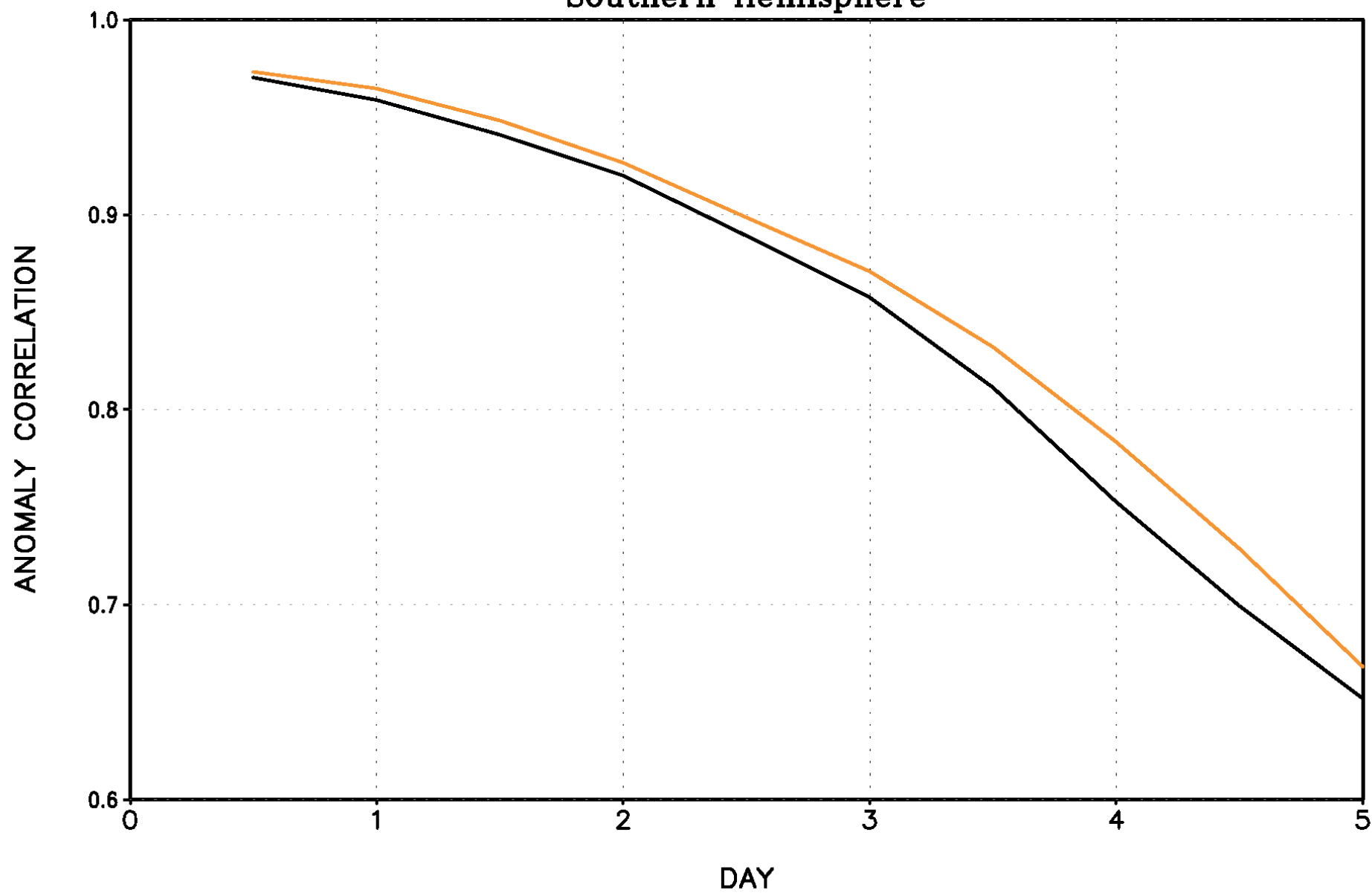
Northern Hemisphere



— f15a1\_d1 Control versus ncep (avg of 13)  
— fvssi13 AIRS Global All Water versus ncep (avg of 13)

# SEA LEVEL PRESSURE

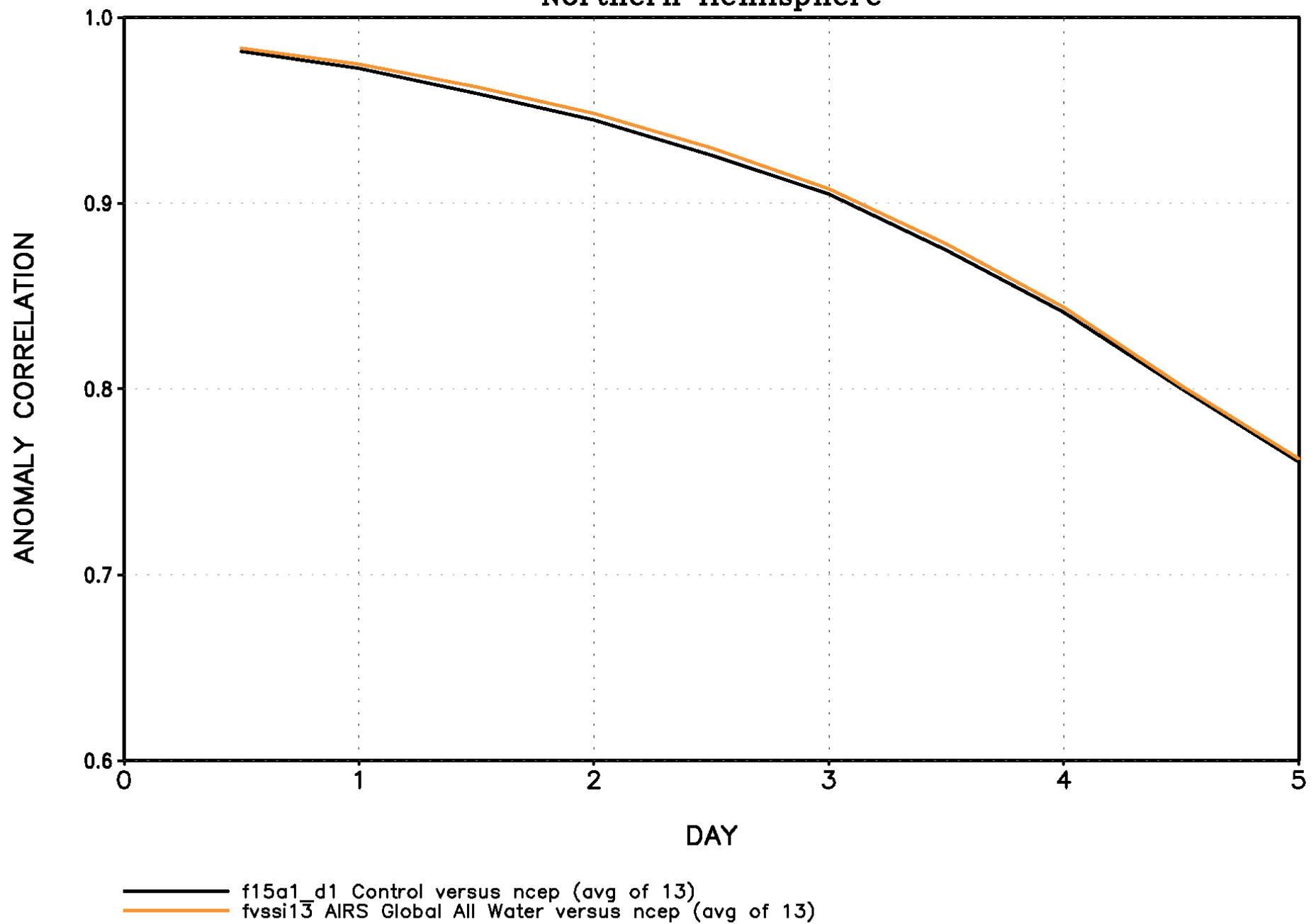
Southern Hemisphere



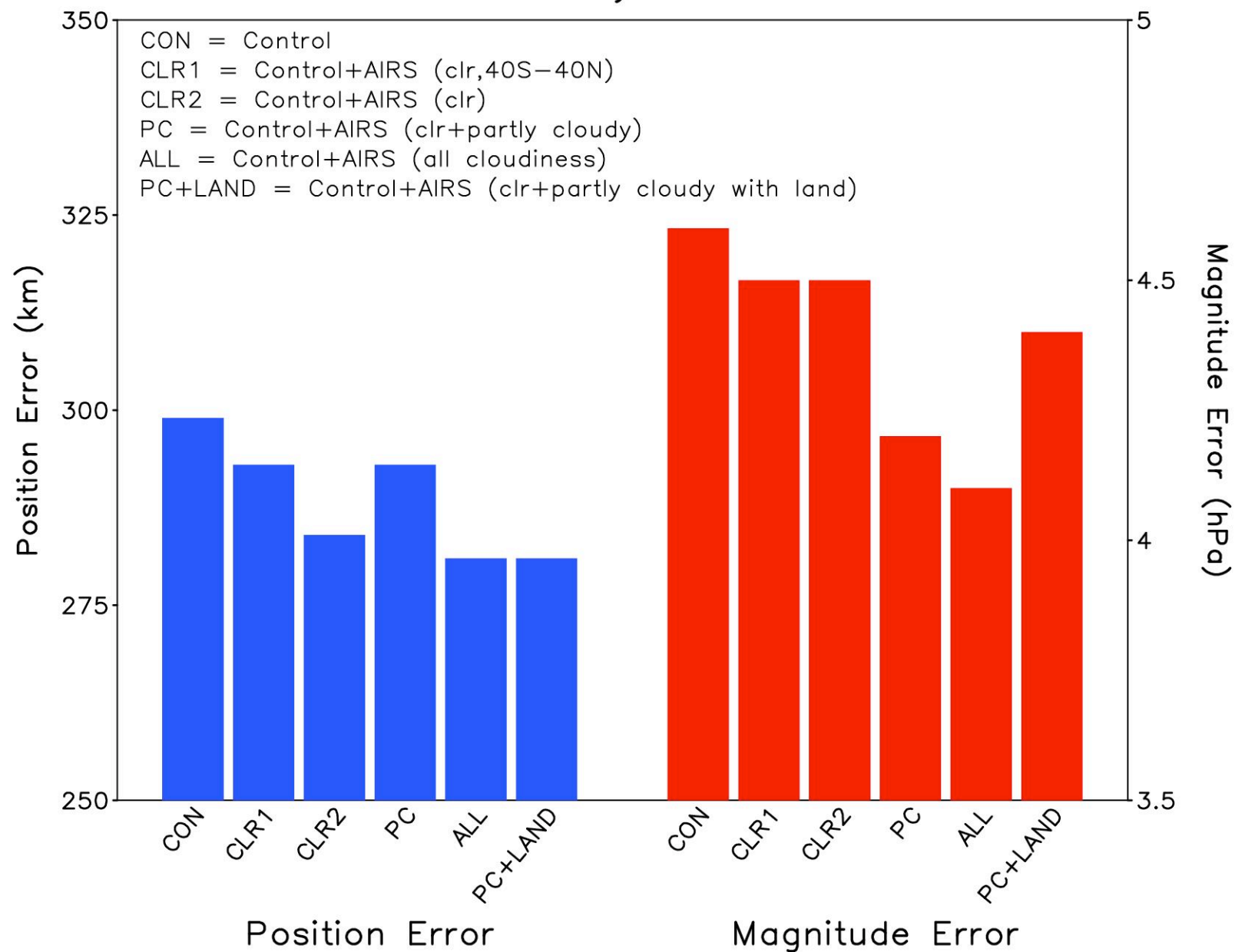
— f15a1\_d1 Control versus ncep (avg of 13)  
— fvssi13 AIRS Global All Water versus ncep (avg of 13)

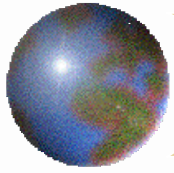
# SEA LEVEL PRESSURE

Northern Hemisphere



# N. Hem. Extratropical Cyclone Forecast Error from 11 Five-day FVSSI Forecasts





# *AIRS Experiments WITH FVDAS*

## GLOBAL DATA ASSIMILATION SYSTEM USED:

fvDAS: fvGCM - Resolution: 1x1.25

PSAS analysis-2x2.5

**PERIOD OF ASSIMILATION:** 1 January - 31 January, 2003

## EXPERIMENTS:

CONTROL: All Conventional Data + CTW + SSM/I TPW + QuikScat + ATOVS  
GLA interactive retrievals

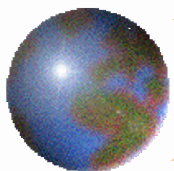
CONTROL + AIRS (Clear +Partly Cloudy/Ocean/Global)

CONTROL + AIRS (Clear +Partly Cloudy/Ocean&Land/Global)

## FORECASTS:

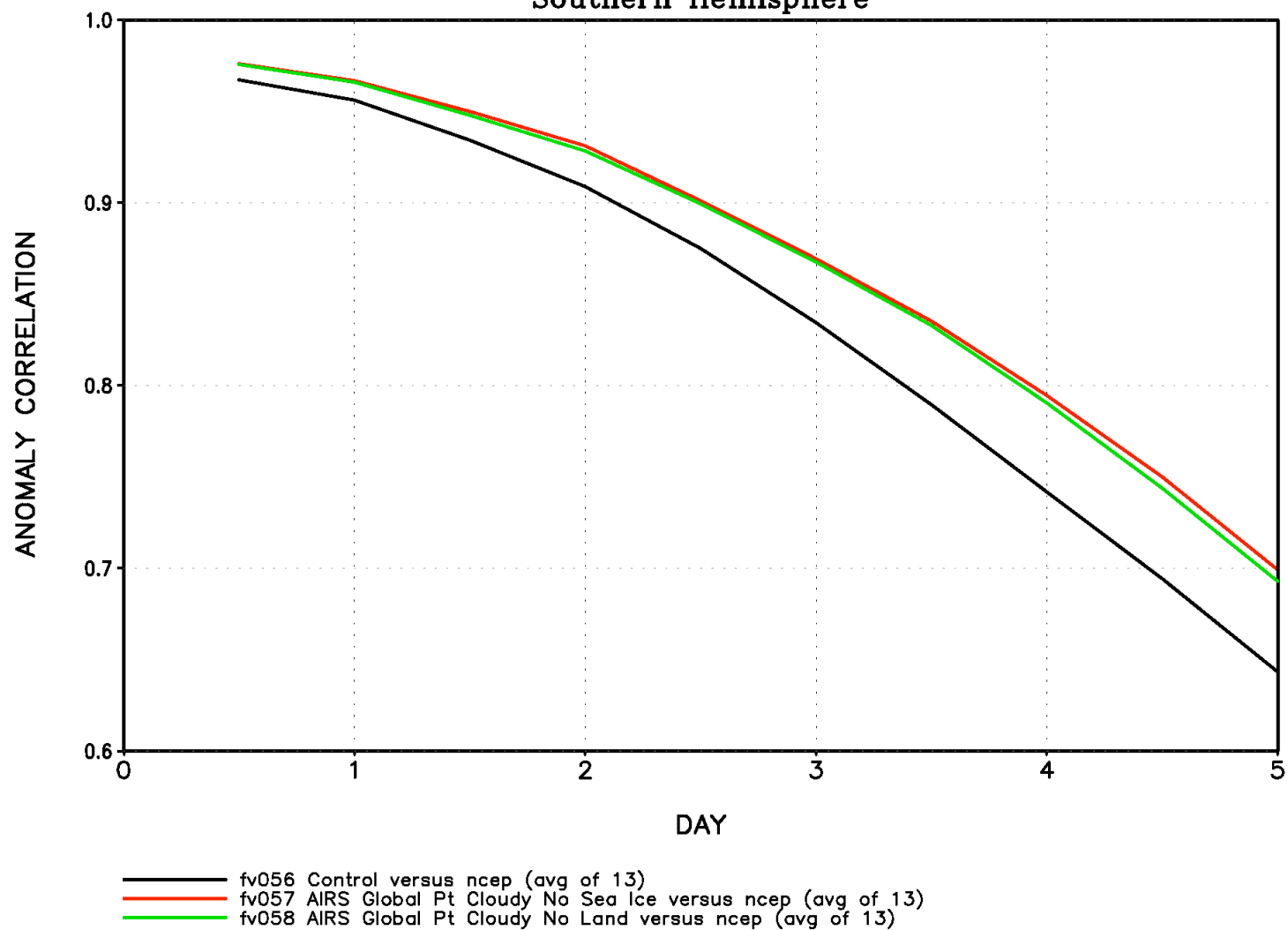
13 forecasts run every two days beginning on 6 January, 2003

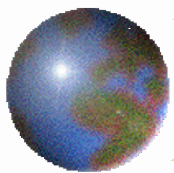




## 500 MB GEOPOTENTIAL HEIGHTS

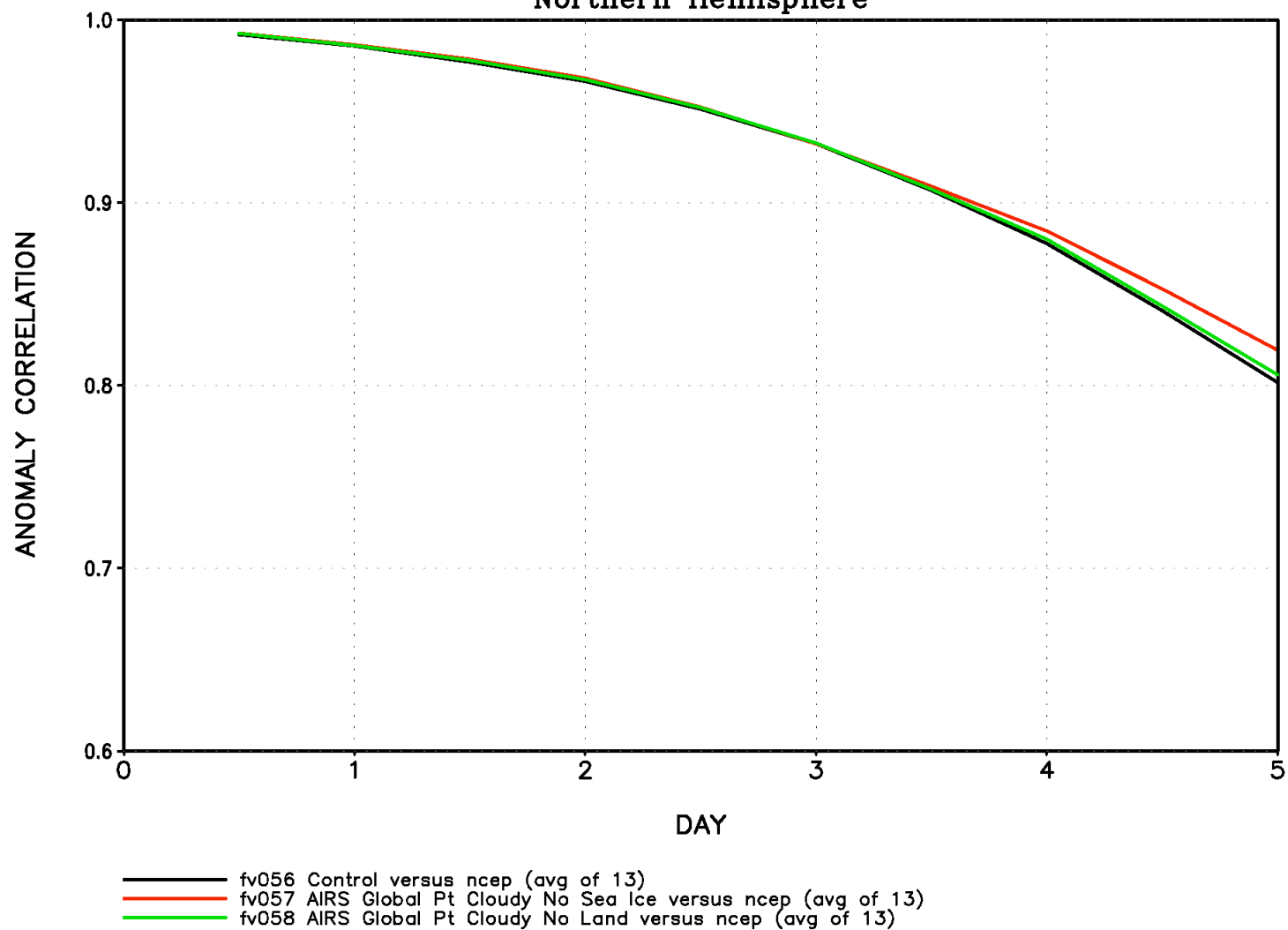
Southern Hemisphere



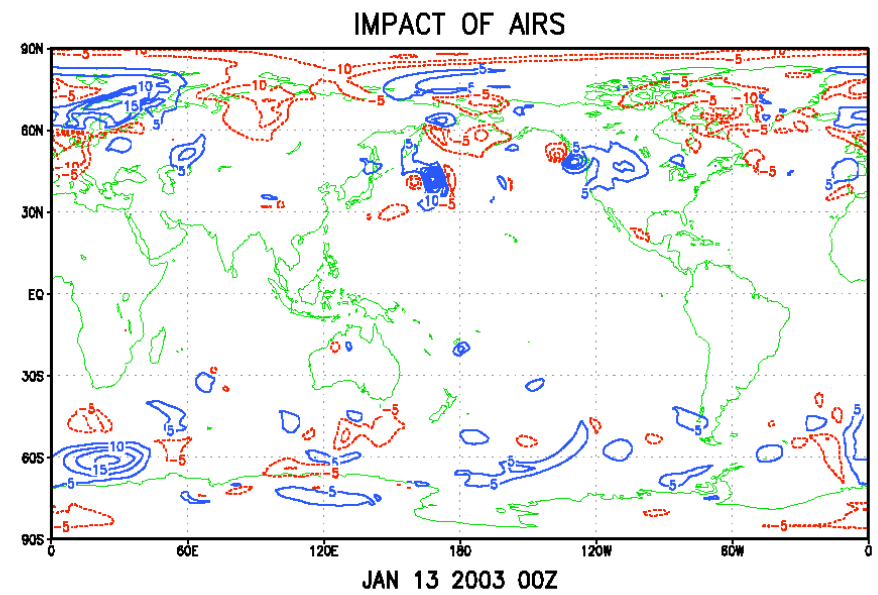
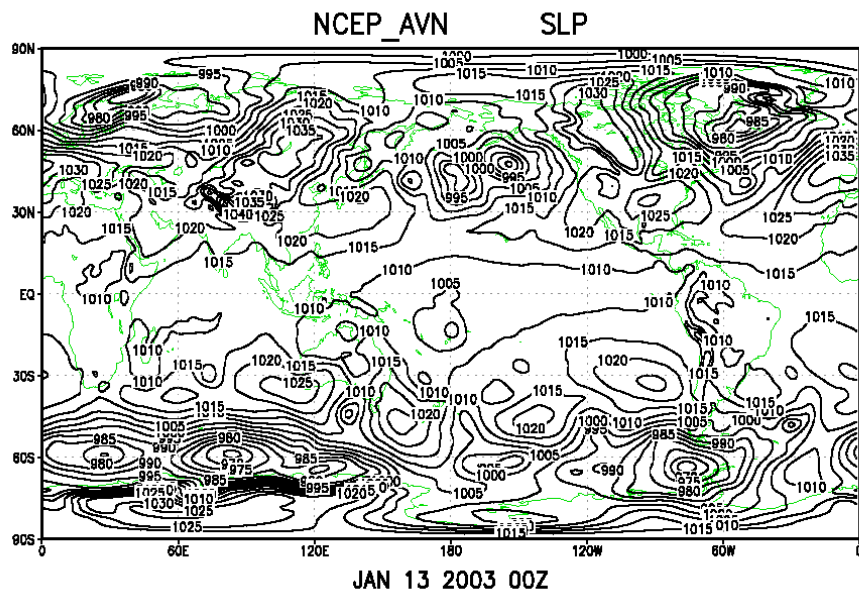
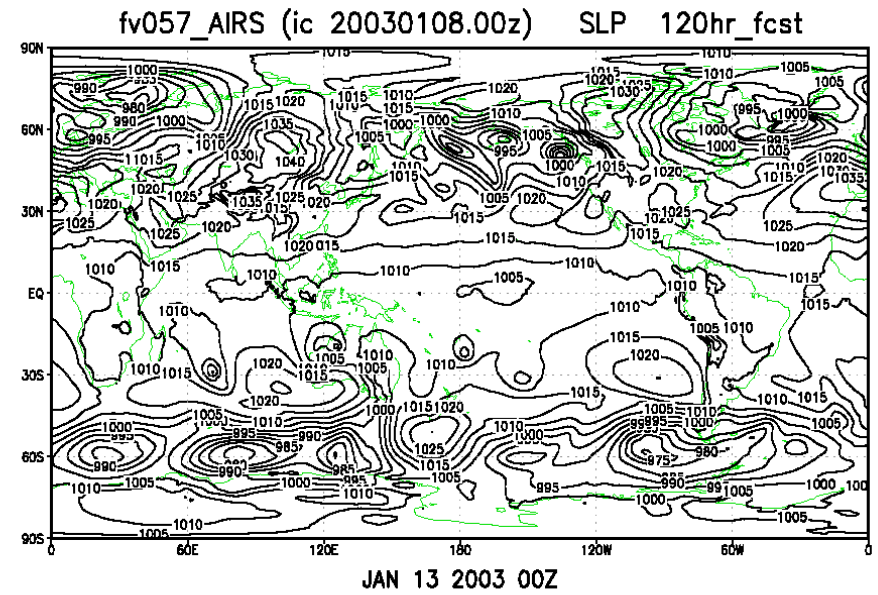
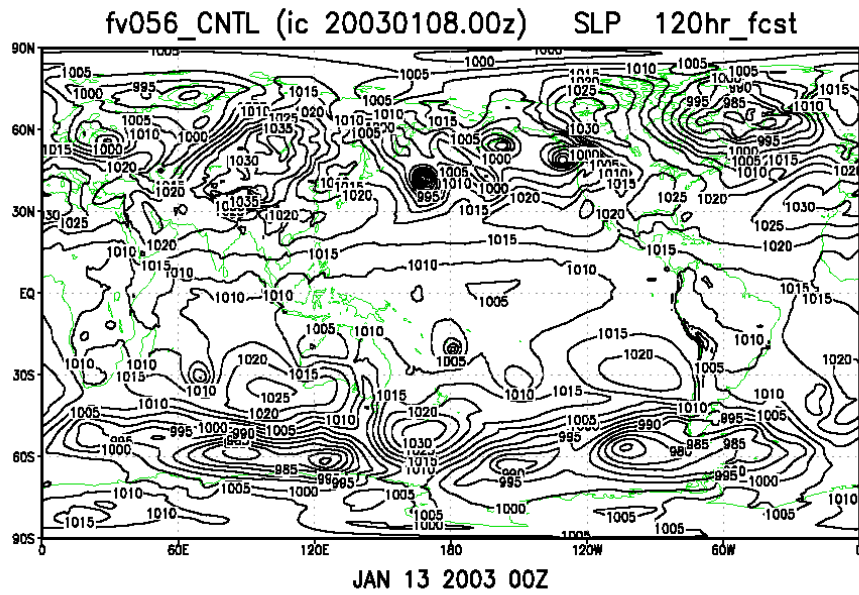


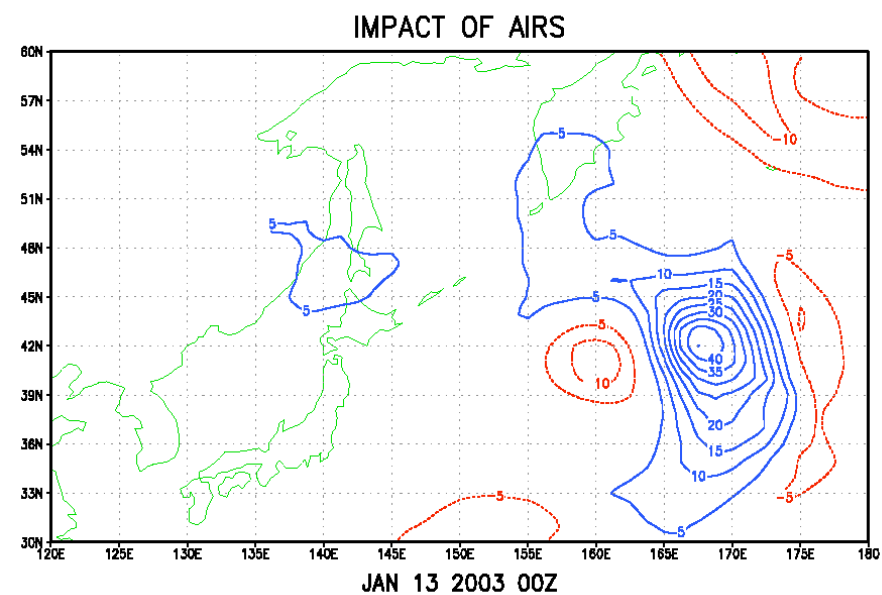
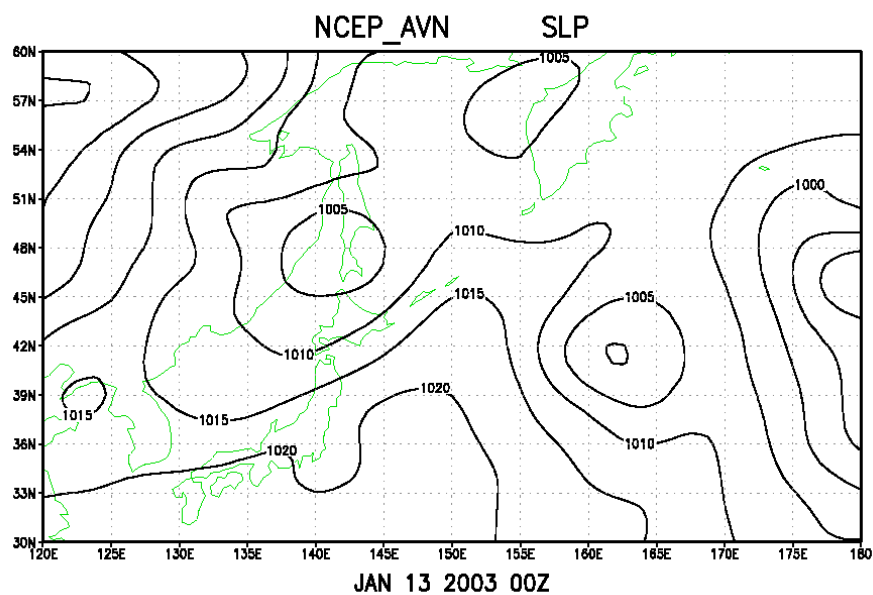
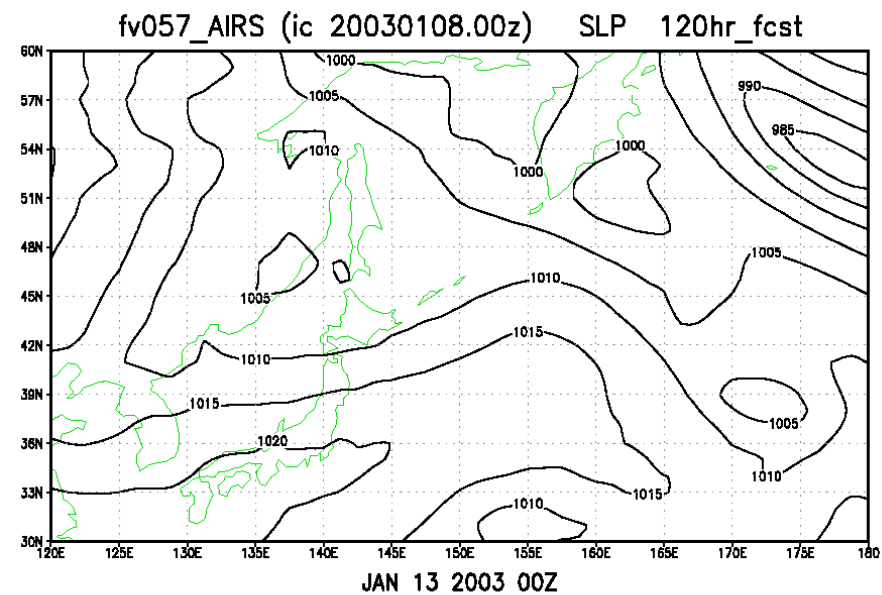
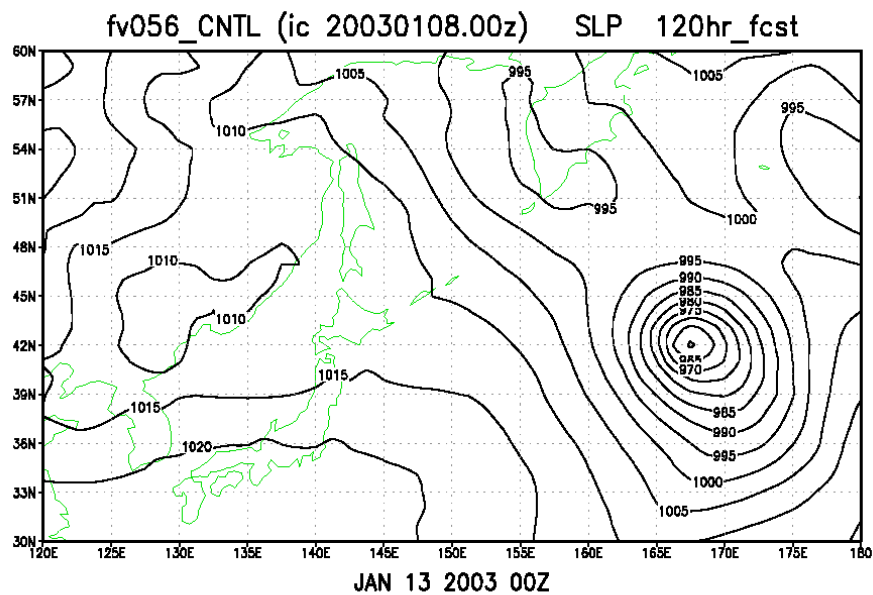
## 500 MB GEOPOTENTIAL HEIGHTS

Northern Hemisphere







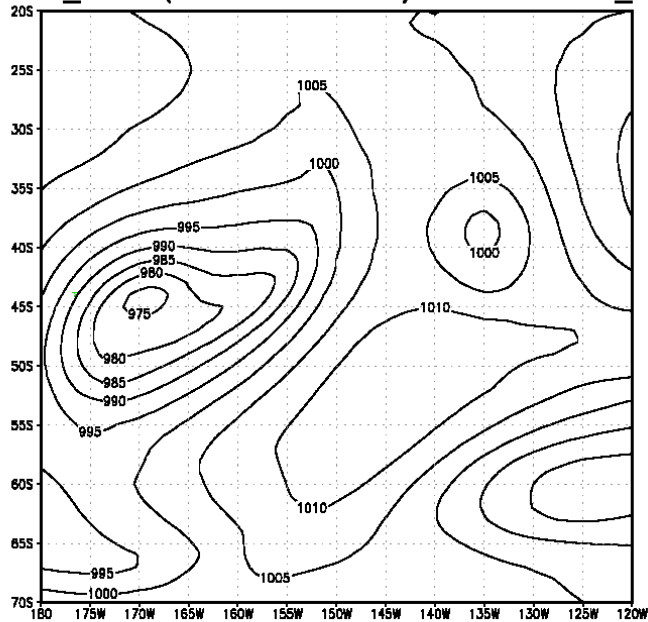






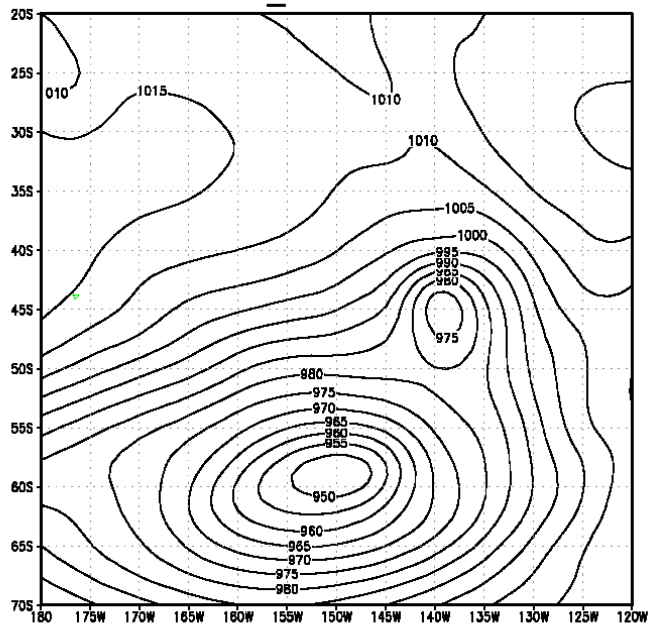


fv056\_CNTL (ic 20030112.00z) SLP 120hr\_fcst



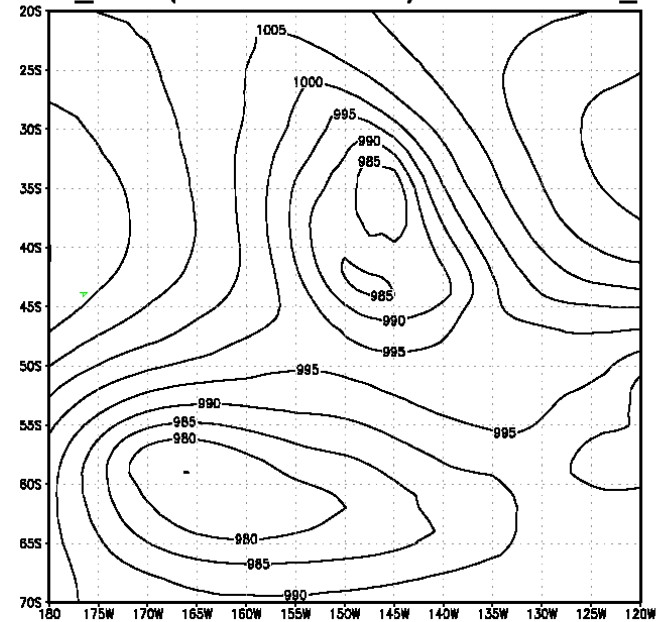
JAN 17 2003 00Z

NCEP\_AVN SLP



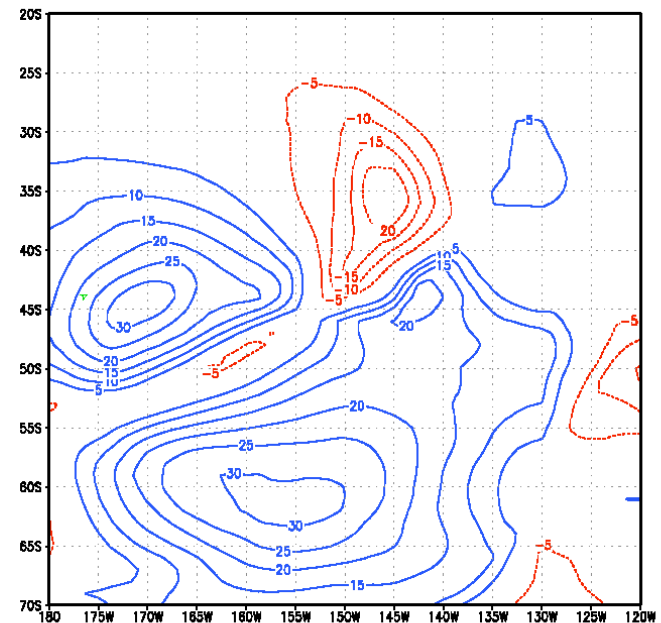
JAN 17 2003 00Z

fv057\_AIRS (ic 20030112.00z) SLP 120hr\_fcst



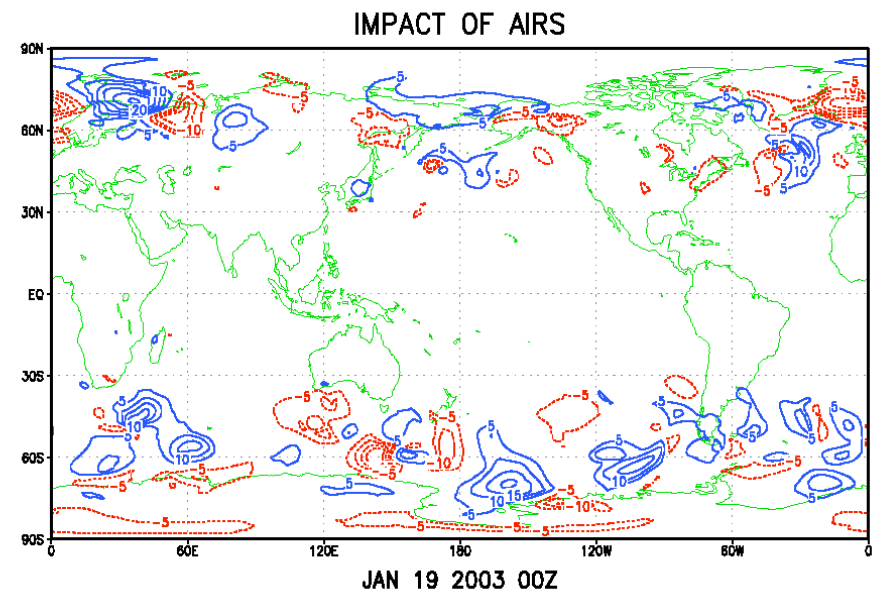
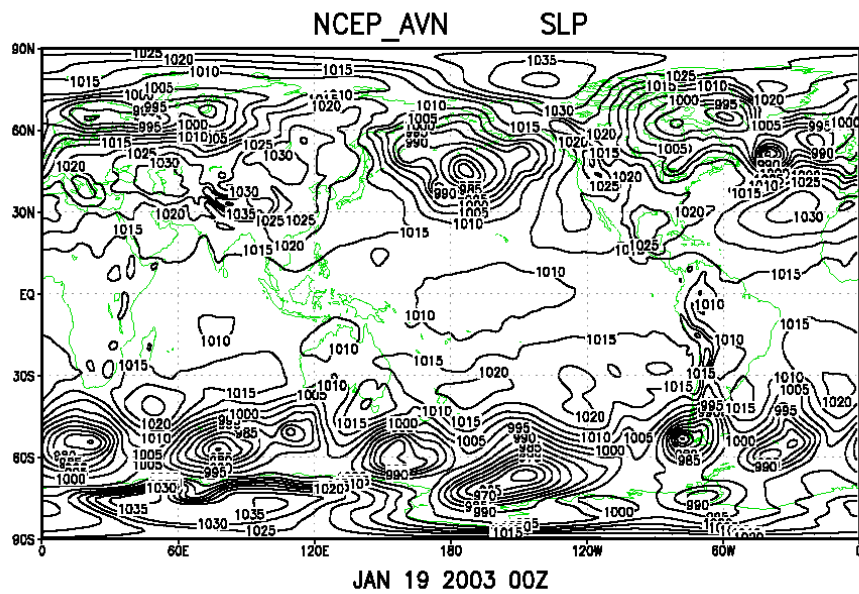
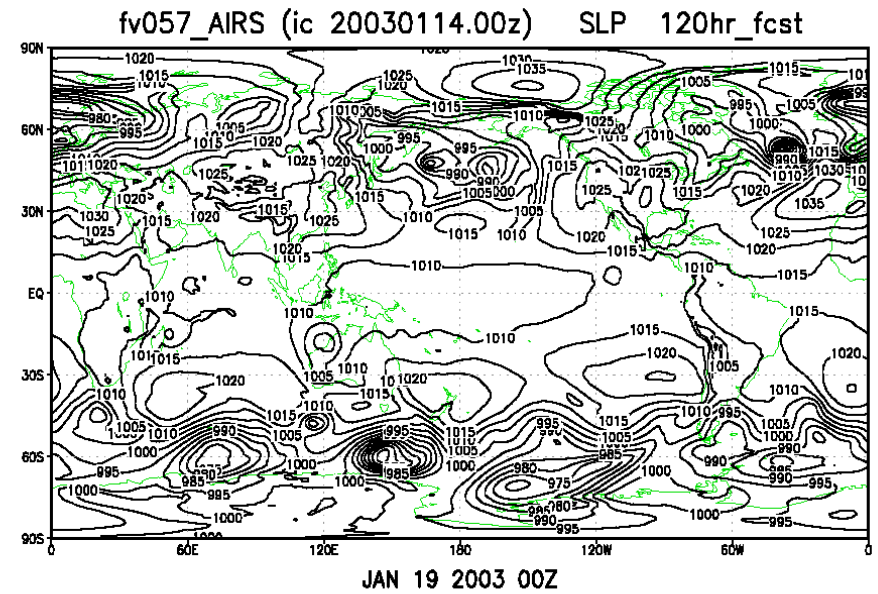
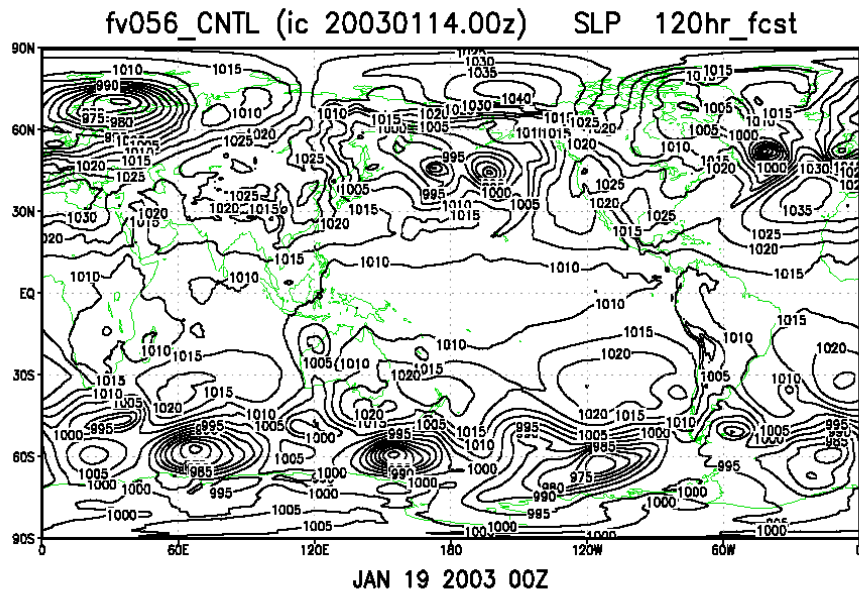
JAN 17 2003 00Z

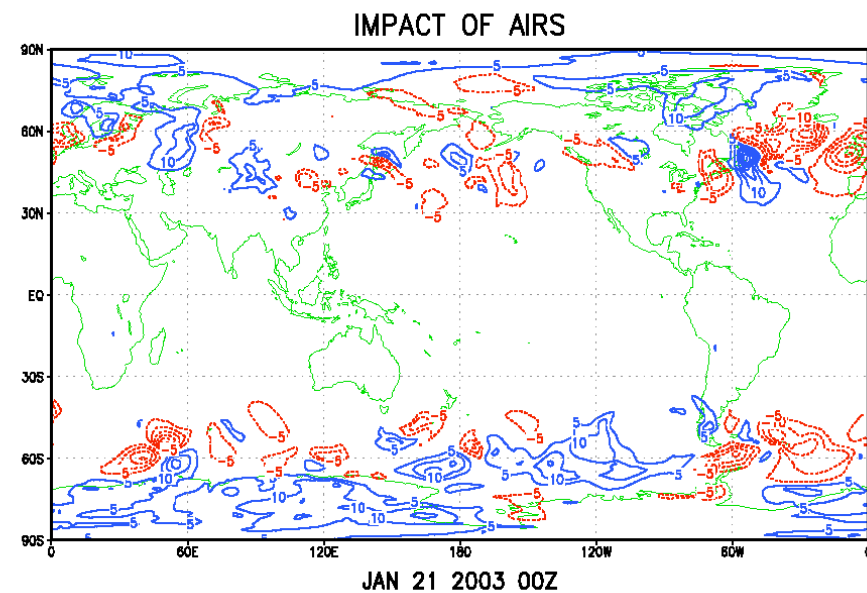
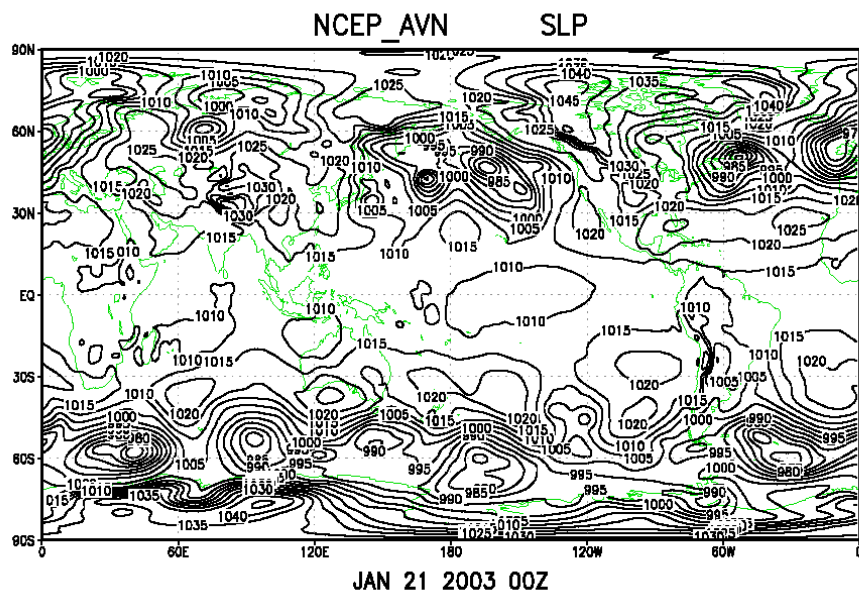
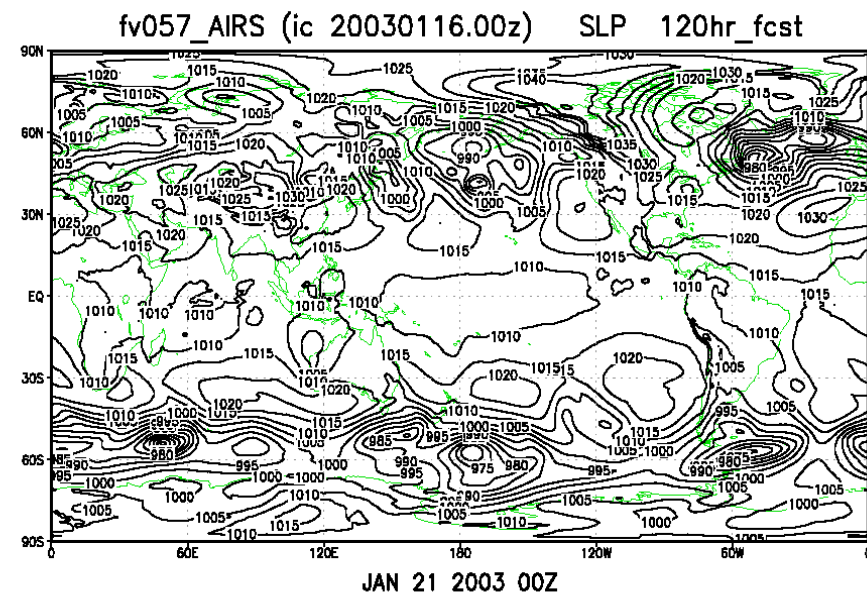
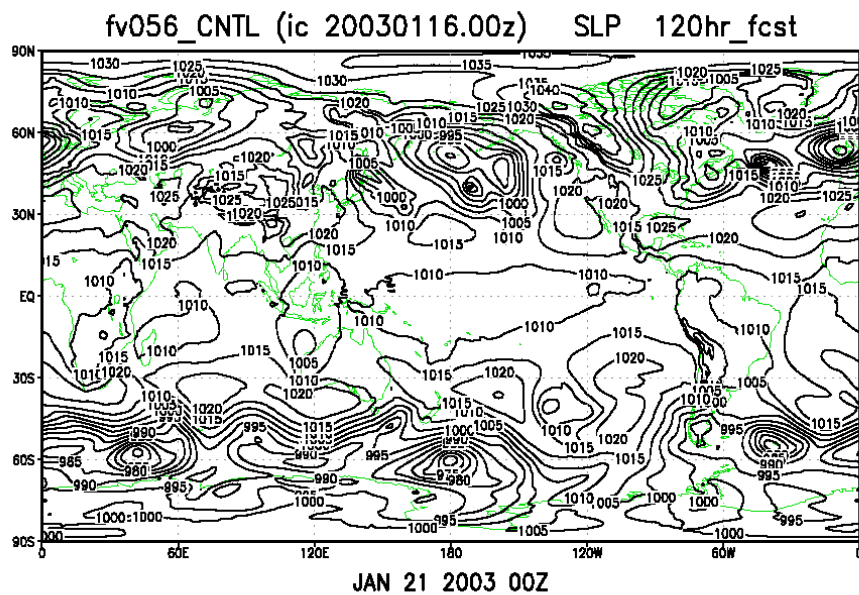
IMPACT OF AIRS

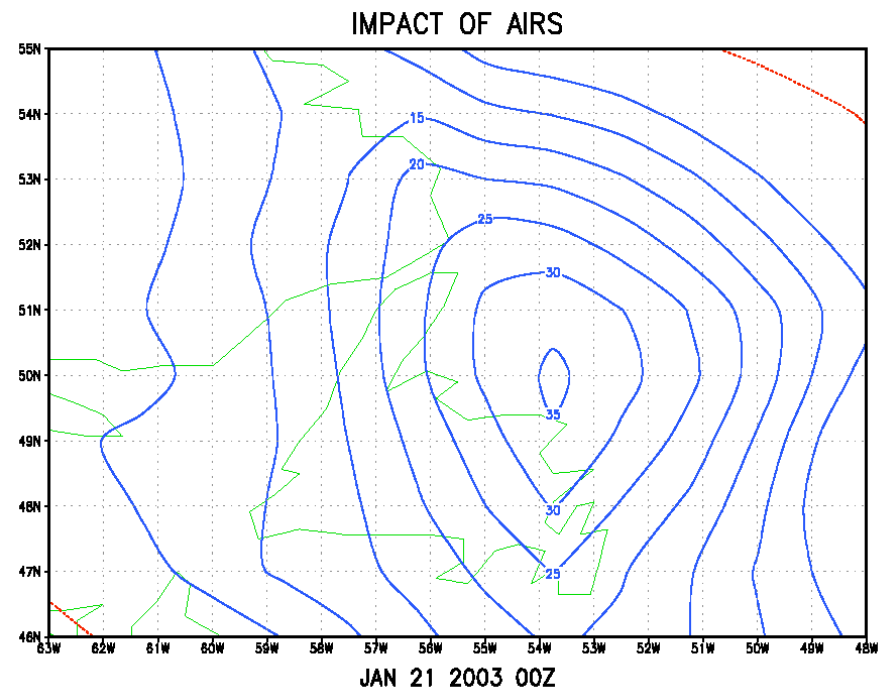
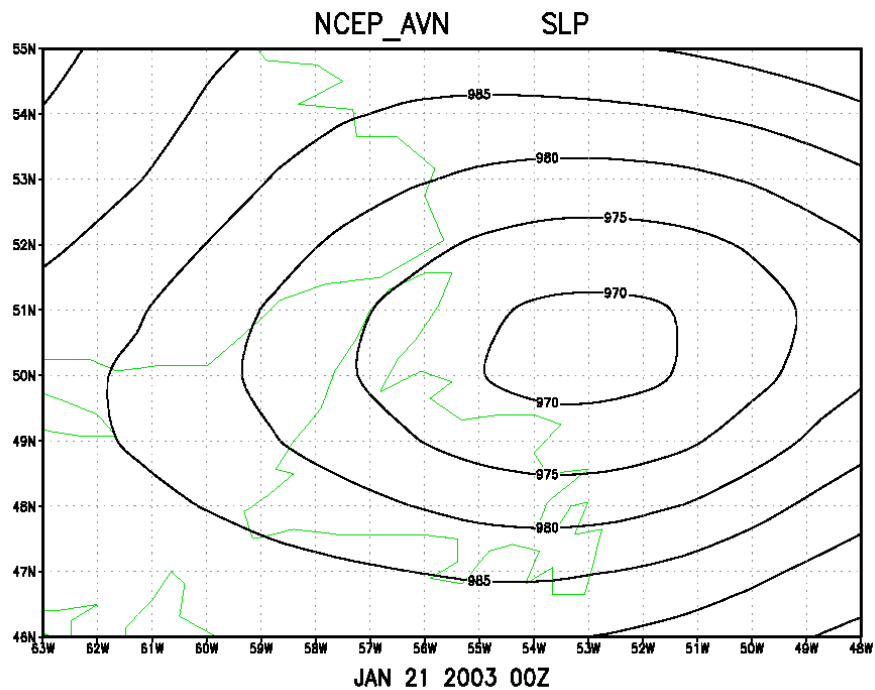
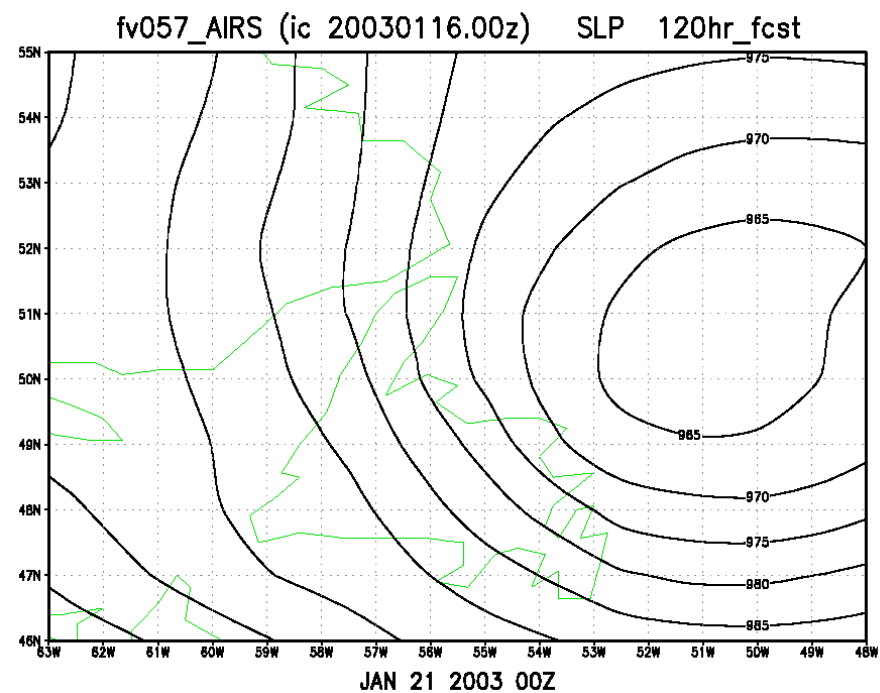
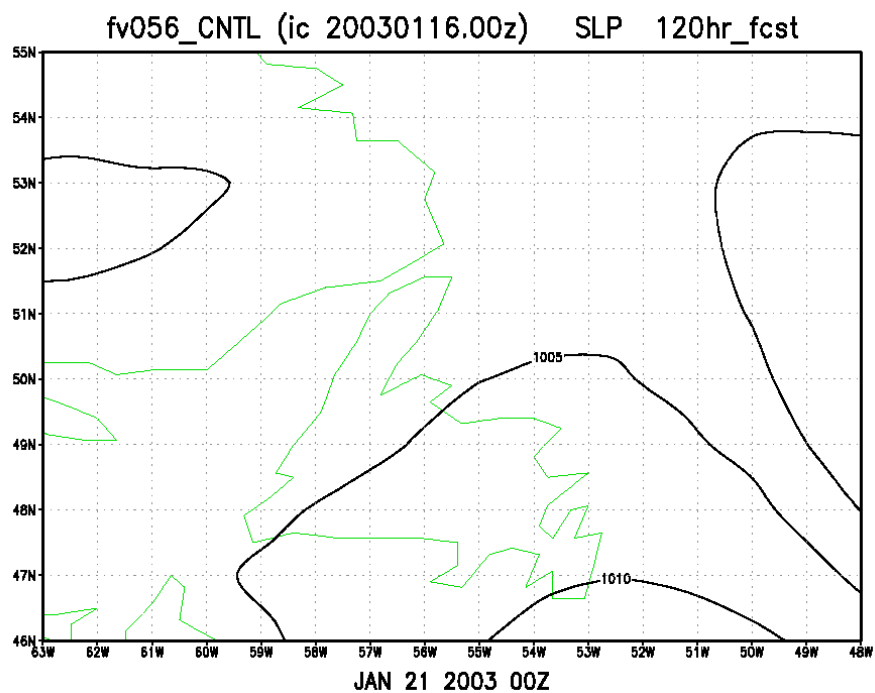


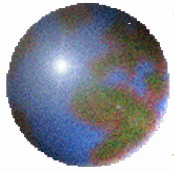
JAN 17 2003 00Z











## *New AIRS Experiments WITH FVSSI*

### GLOBAL DATA ASSIMILATION SYSTEM USED:

fvSSI: fvGCM - Resolution: 1x1.25

SSI (NCEP) analysis-T62

PERIOD OF ASSIMILATION: 1 January - 31 January, 2003

### EXPERIMENTS:

CONTROL: All Conventional Data + ATOVS + Radiance (NOAA-14, 15, 16)  
+ CTW + SSM/I TPW+ SSM/I Wind Speed + QuikScat + Ozone

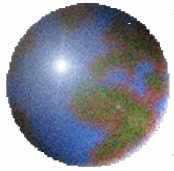
CONTROL + AIRS Temperatures (Clear/Ocean/Global)

CONTROL + AIRS Temperatures (Clear +Partly Cloudy/Ocean/Global)

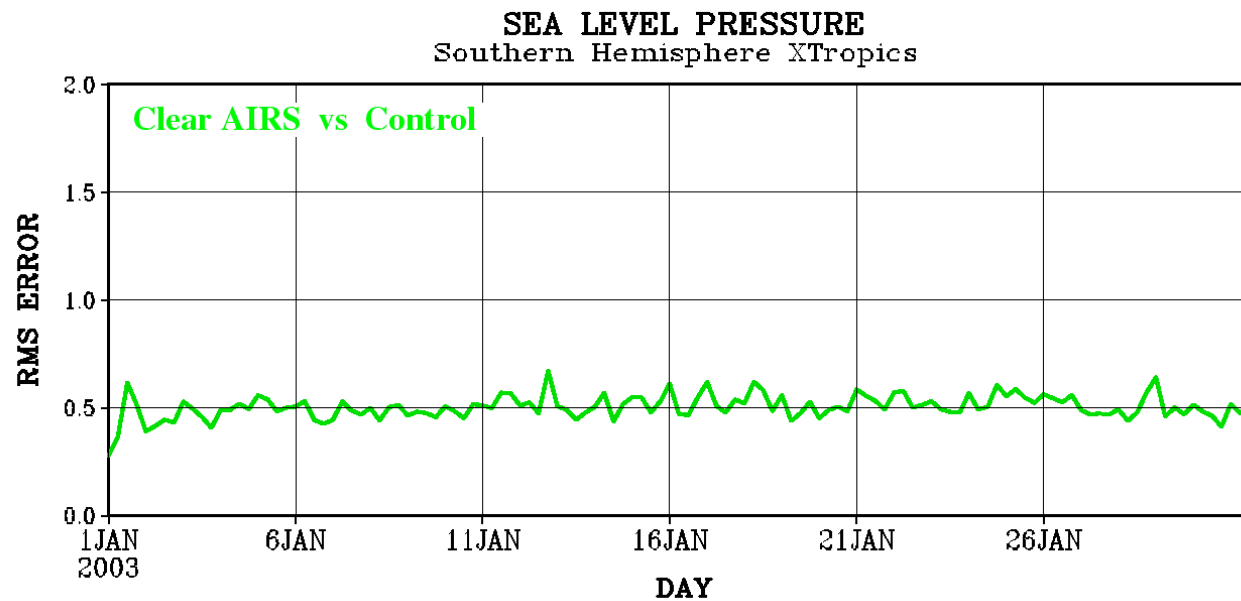
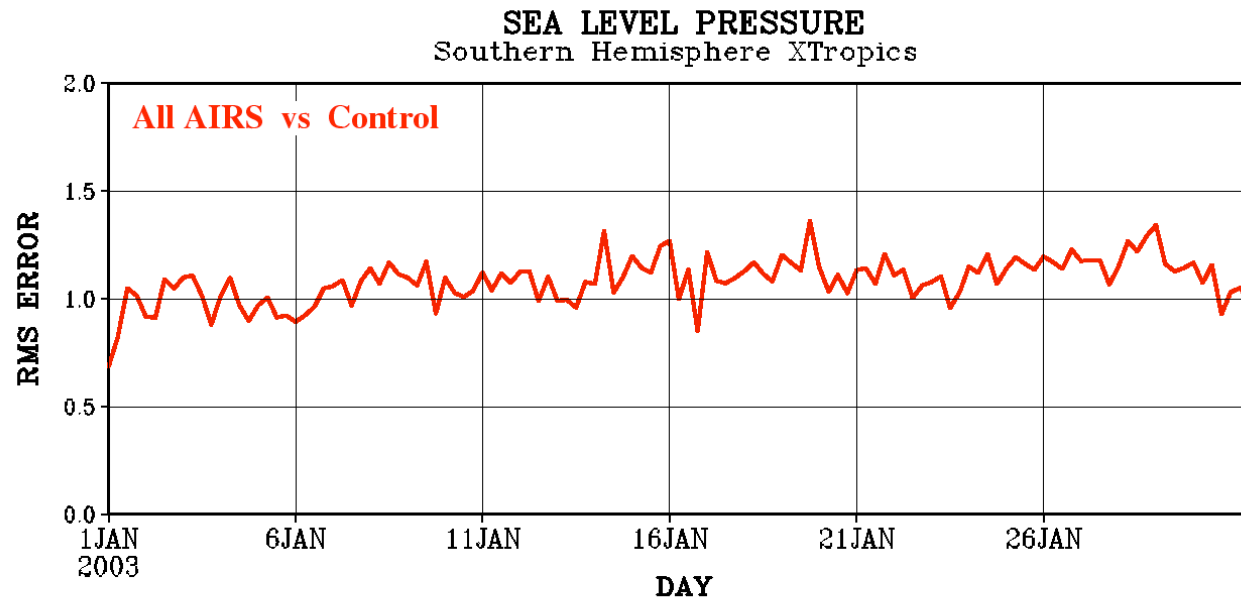
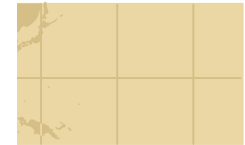
CONTROL + AIRS Temperatures plus moisture profiles

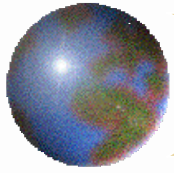
### FORECASTS:

26 forecasts run every day beginning on 6 January, 2003

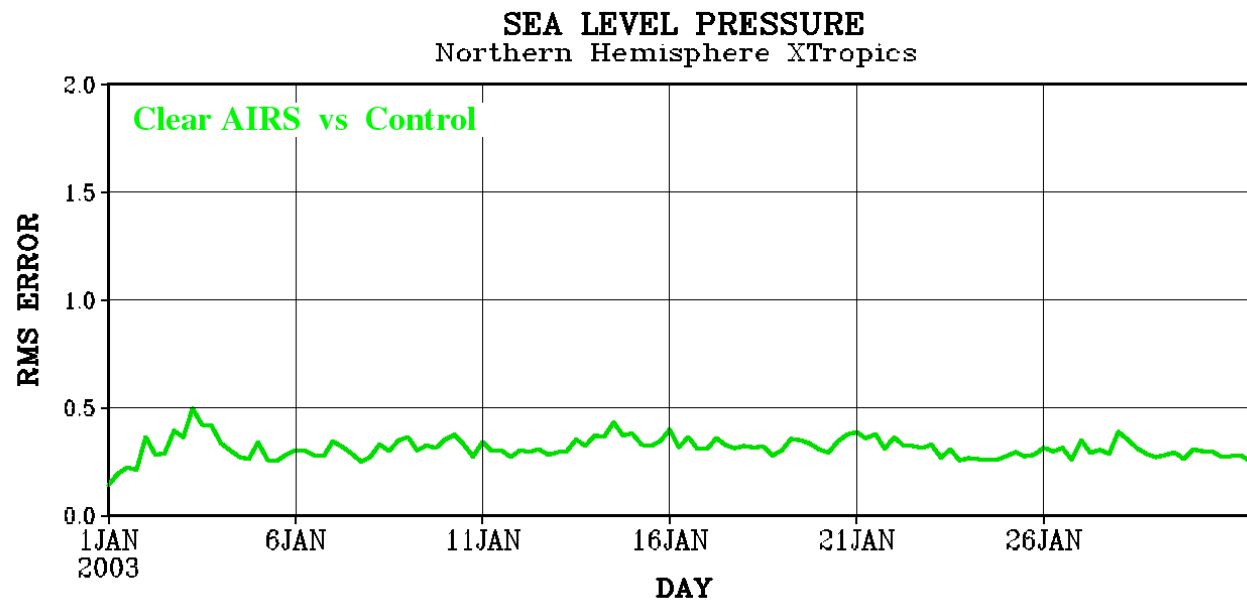
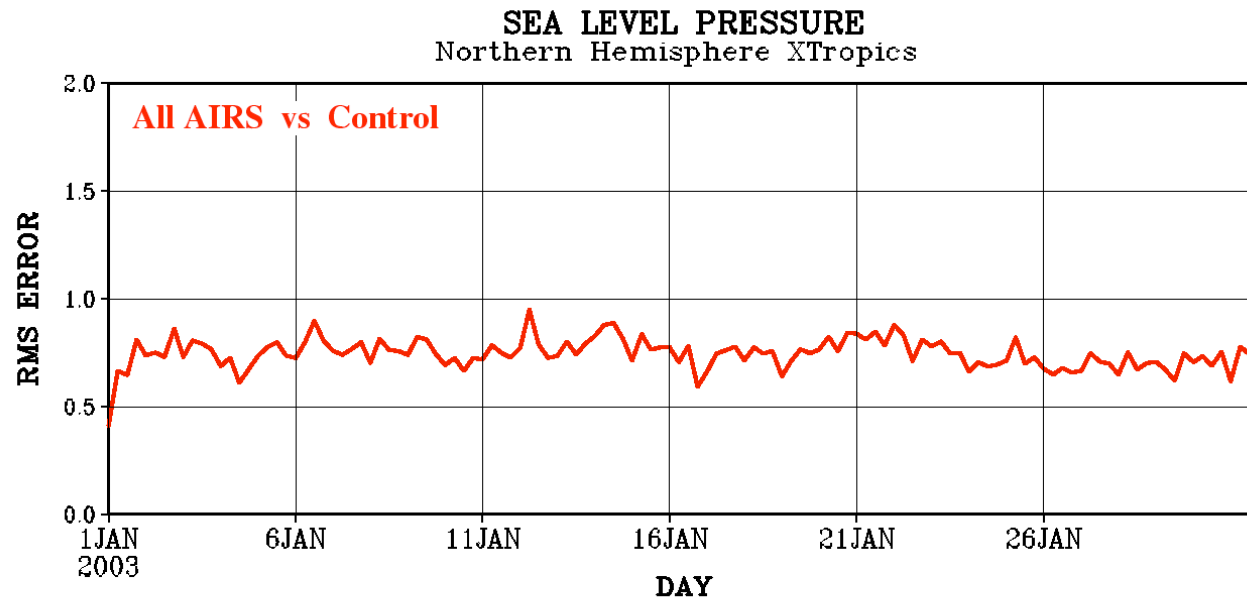


## Impact of AIRS on Sea Level Pressure Analysis

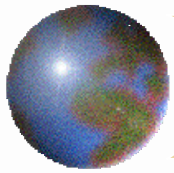




## Impact of AIRS on Sea Level Pressure Analysis



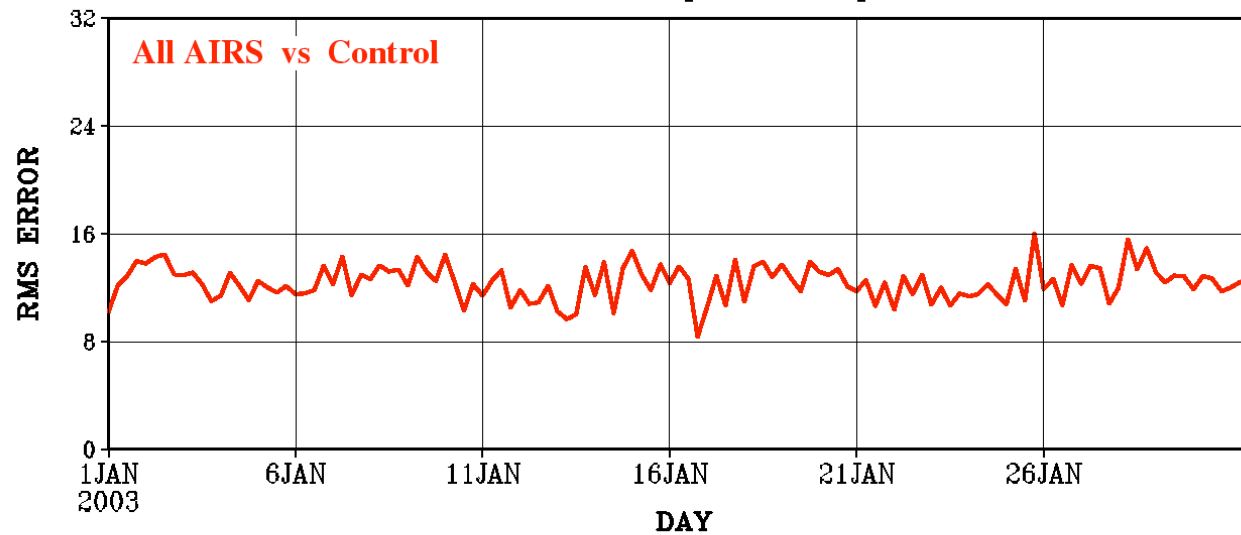




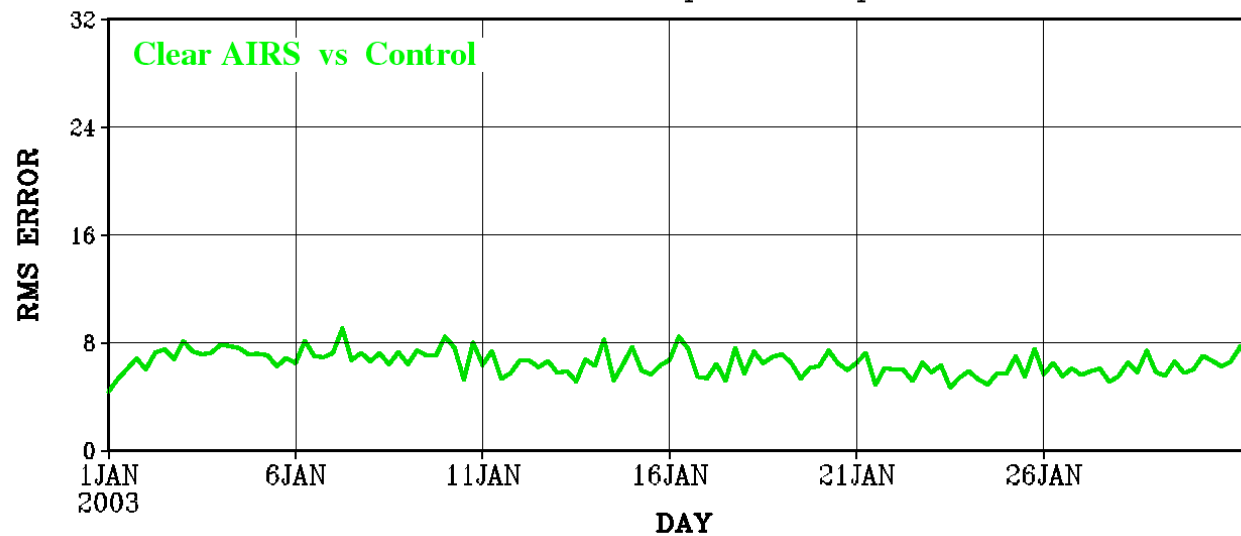
# Impact of AIRS on 500 mb Geopotential Height Analysis

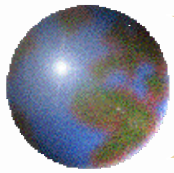


500 MB GEOPOTENTIAL HEIGHT  
Southern Hemisphere XTropics



500 MB GEOPOTENTIAL HEIGHT  
Southern Hemisphere XTropics

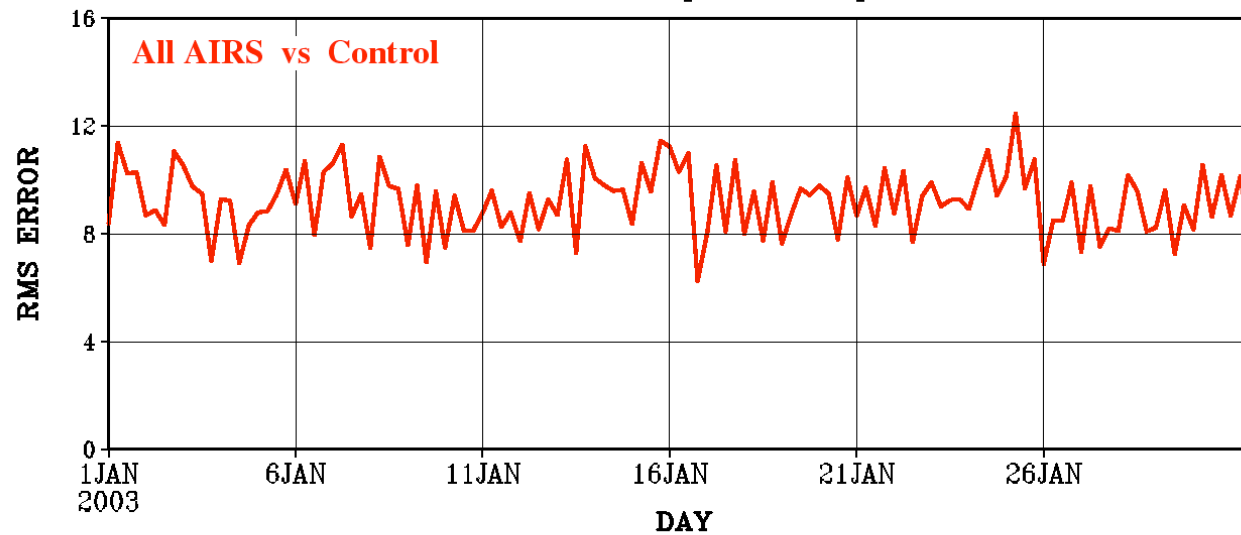




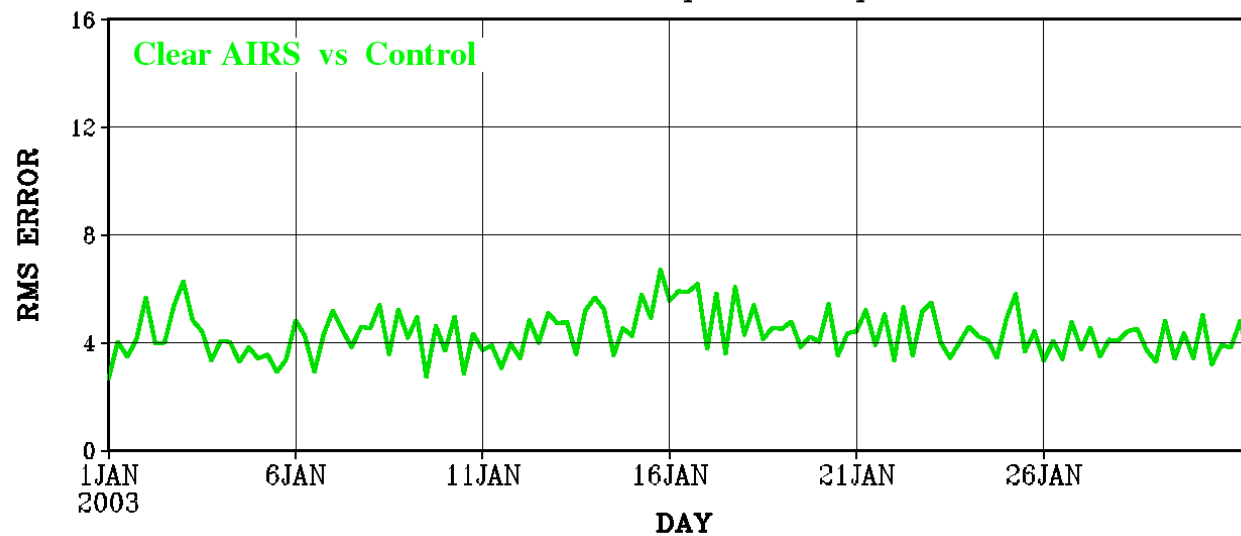
# Impact of AIRS on 500mb Geopotential Height Analysis



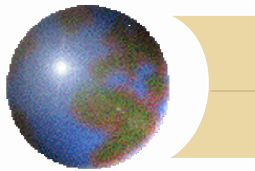
500 MB GEOPOTENTIAL HEIGHT  
Northern Hemisphere XTropics



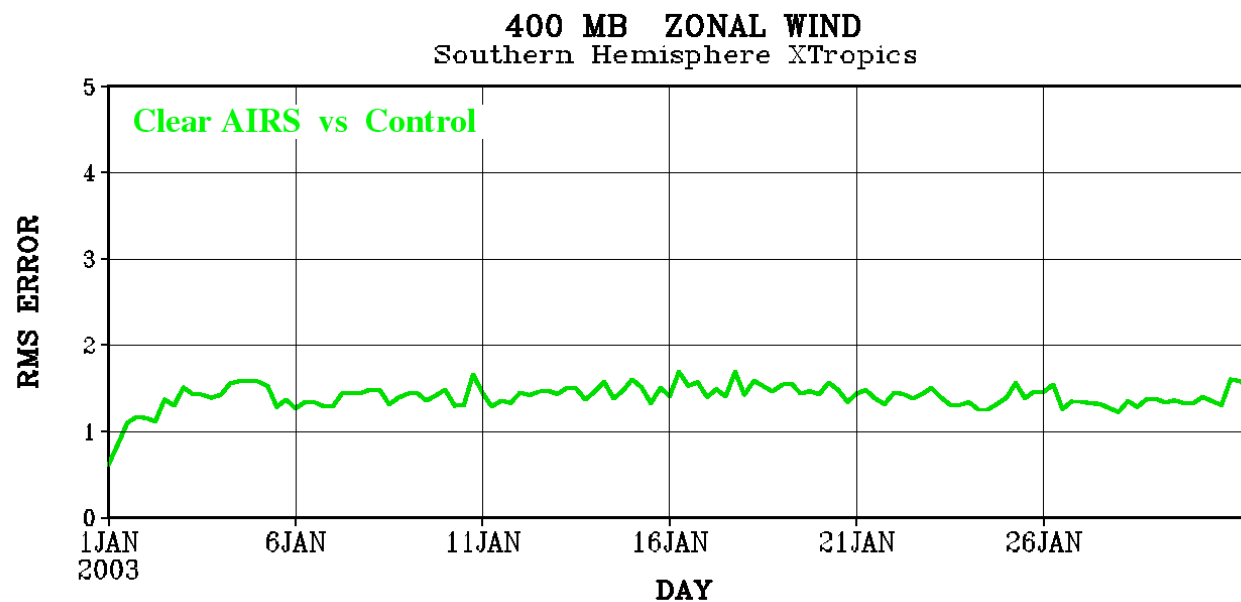
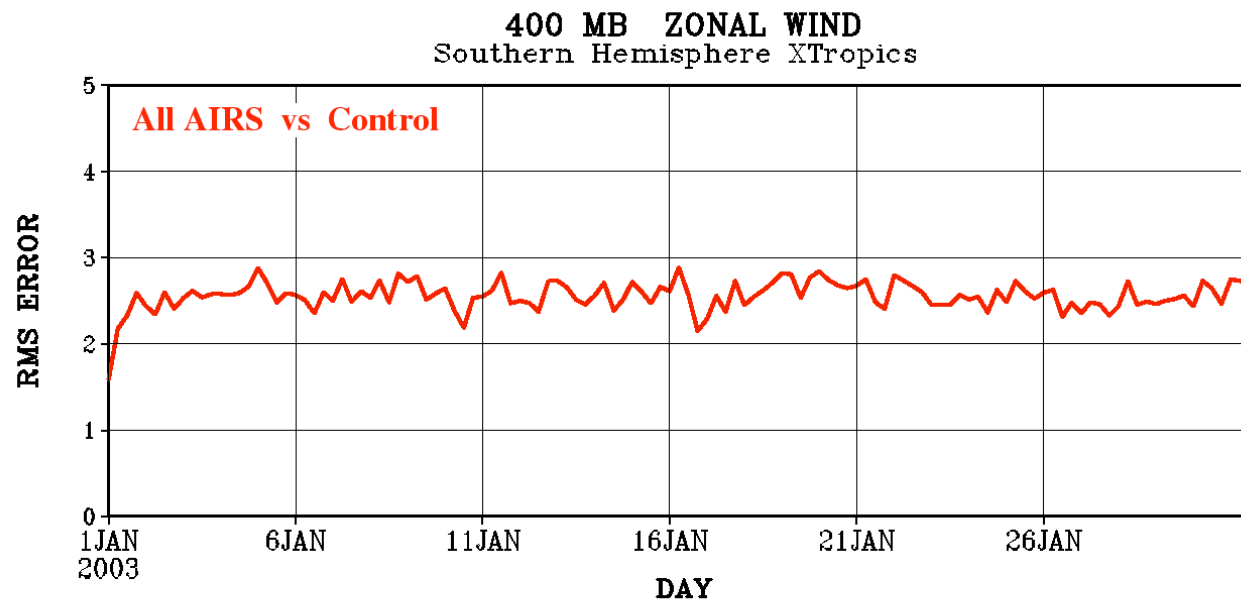
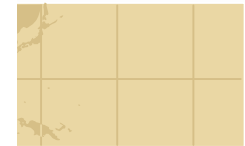
500 MB GEOPOTENTIAL HEIGHT  
Northern Hemisphere XTropics

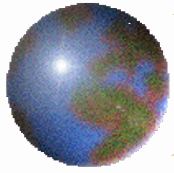




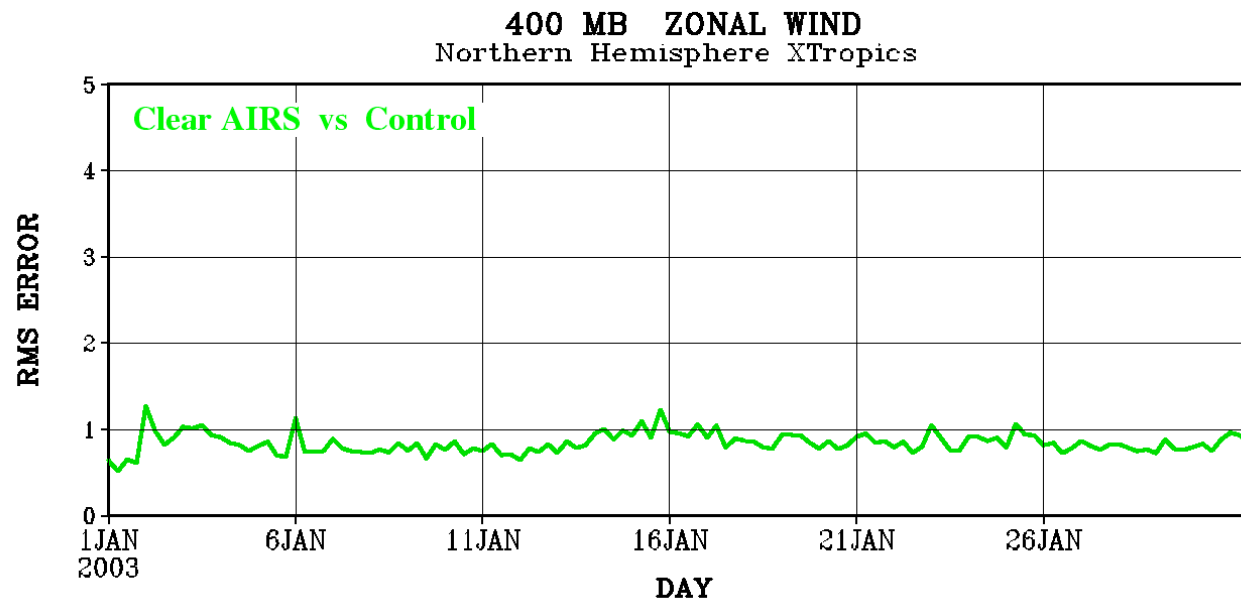
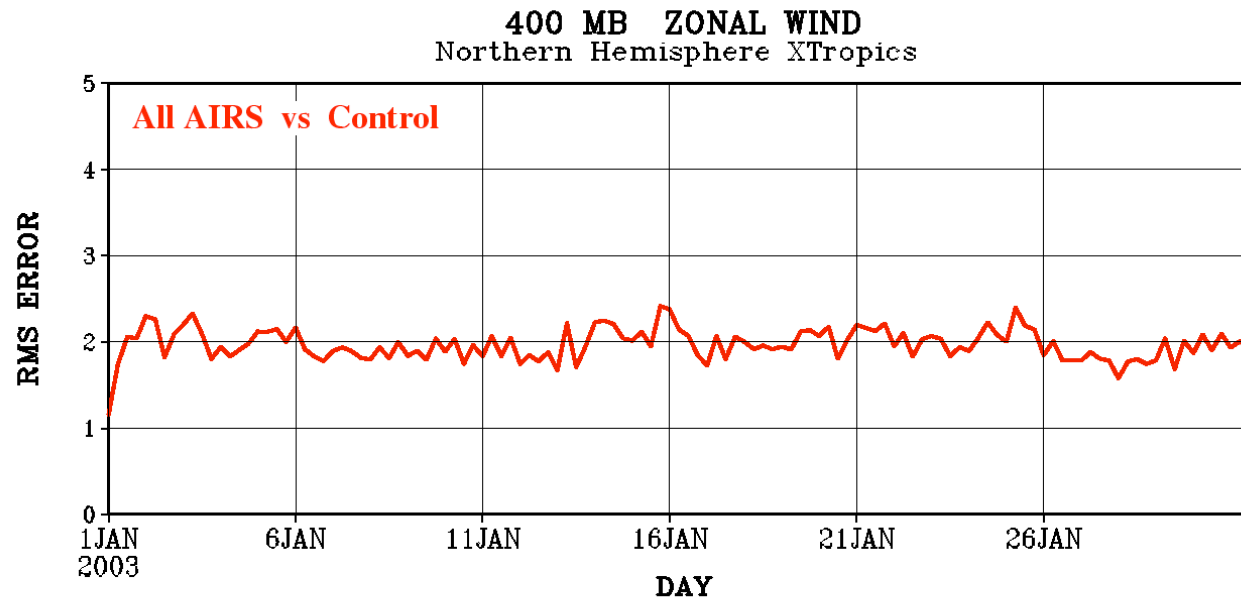


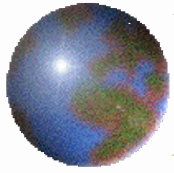
## Impact of AIRS on 400 mb Zonal Wind Analysis



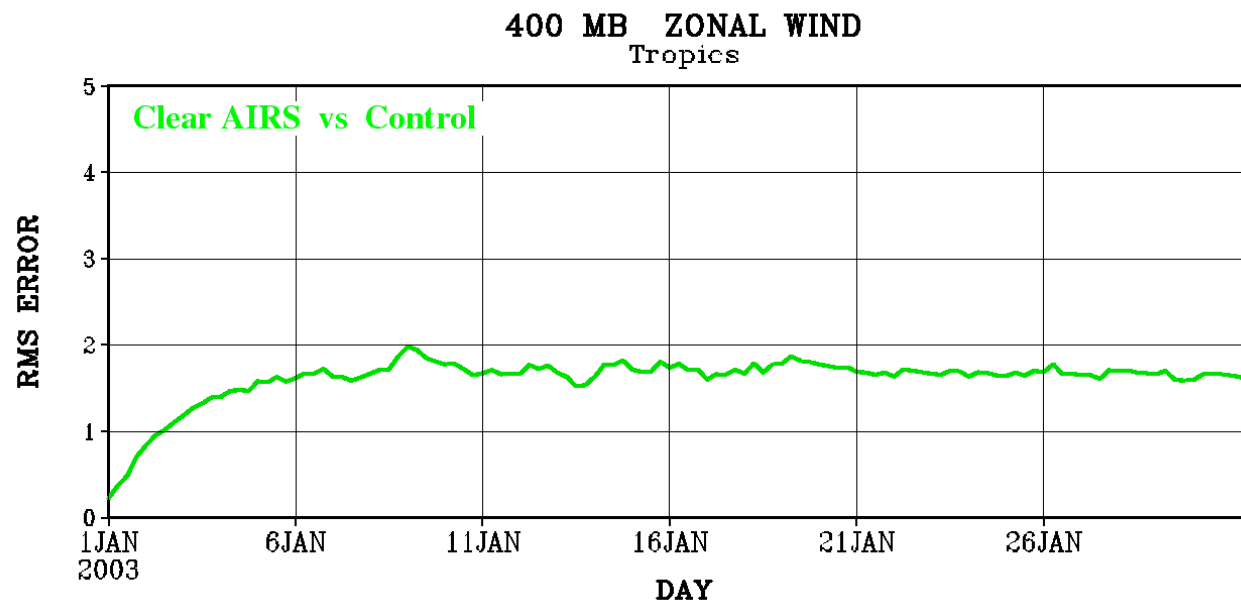
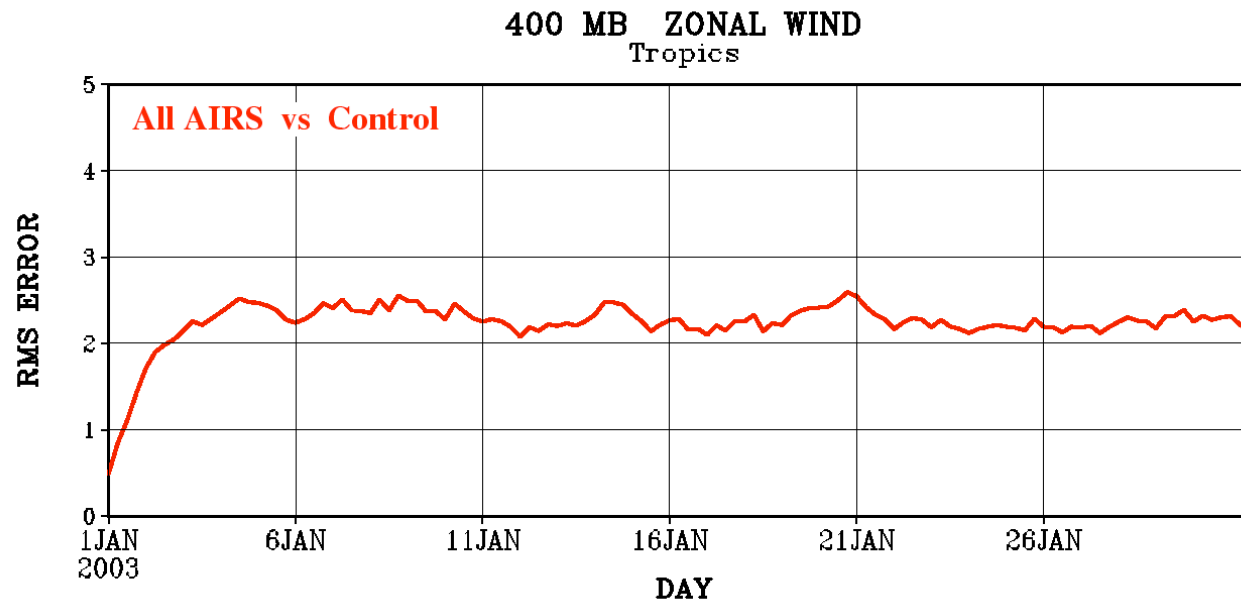
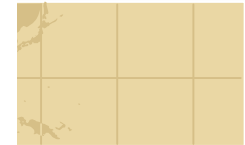


## Impact of AIRS on 400 mb Zonal Wind Analysis





## Impact of AIRS on 400 mb Zonal Wind Analysis

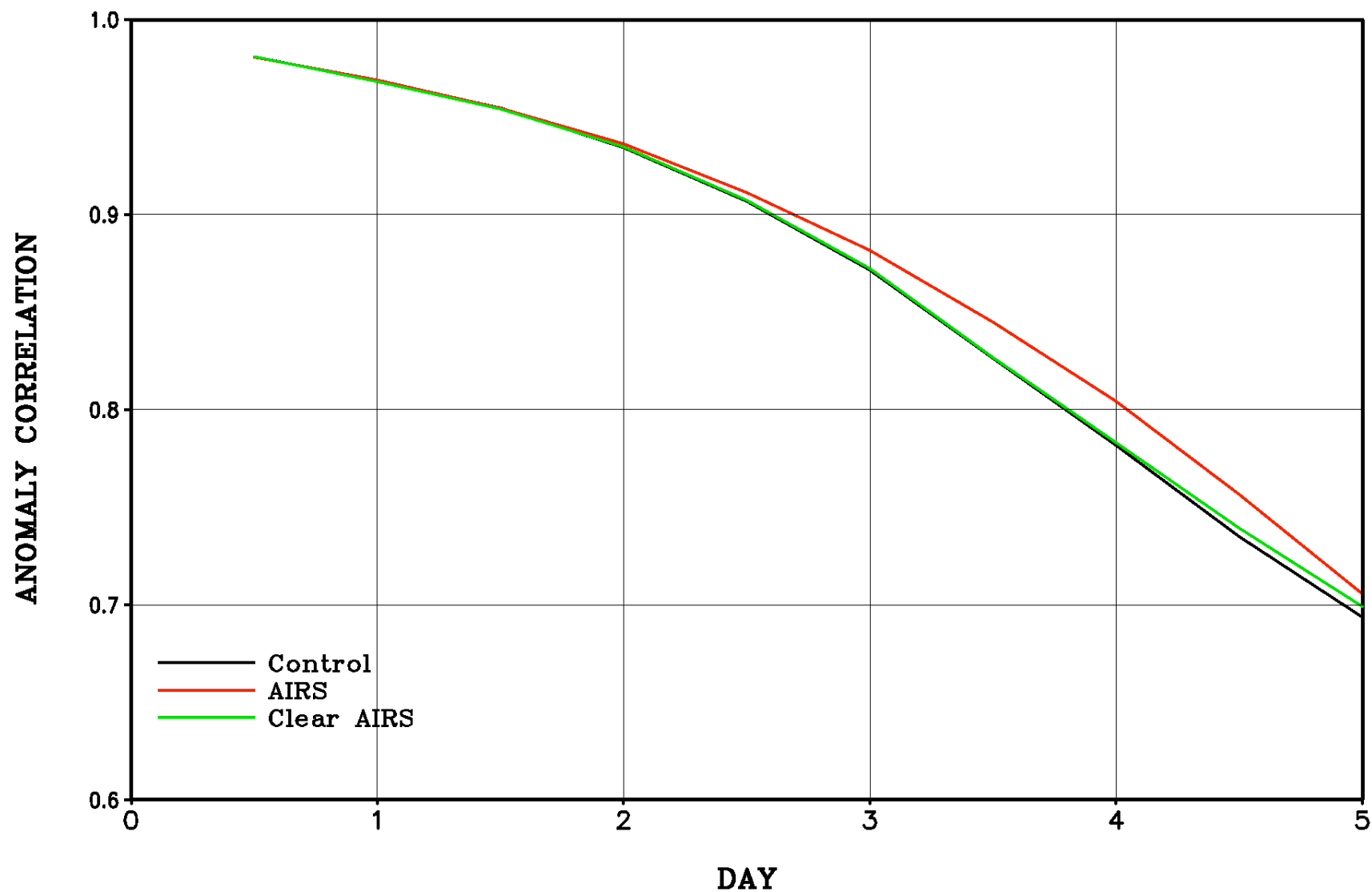


# Impact of AIRS on fvSSI Forecasts

Average of 26 Five-Day Forecasts

## SEA LEVEL PRESSURE

Southern Hemisphere



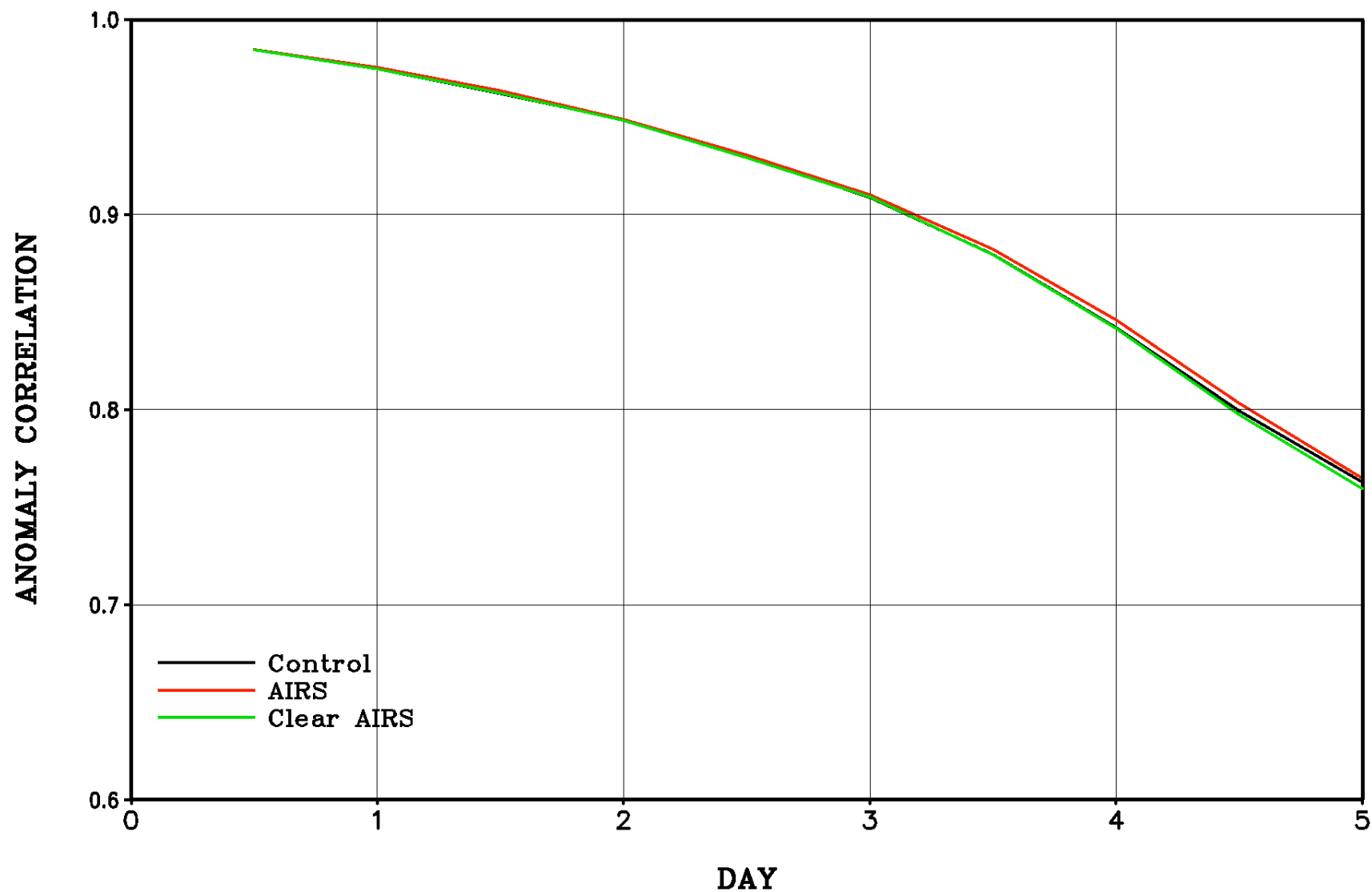
fv15+1 ctrl vs ncep  
fvss105 vs acep  
fvss127 vs acep

# Impact of AIRS on fvSSI Forecasts

Average of 26 Five-Day Forecasts

## SEA LEVEL PRESSURE

Northern Hemisphere

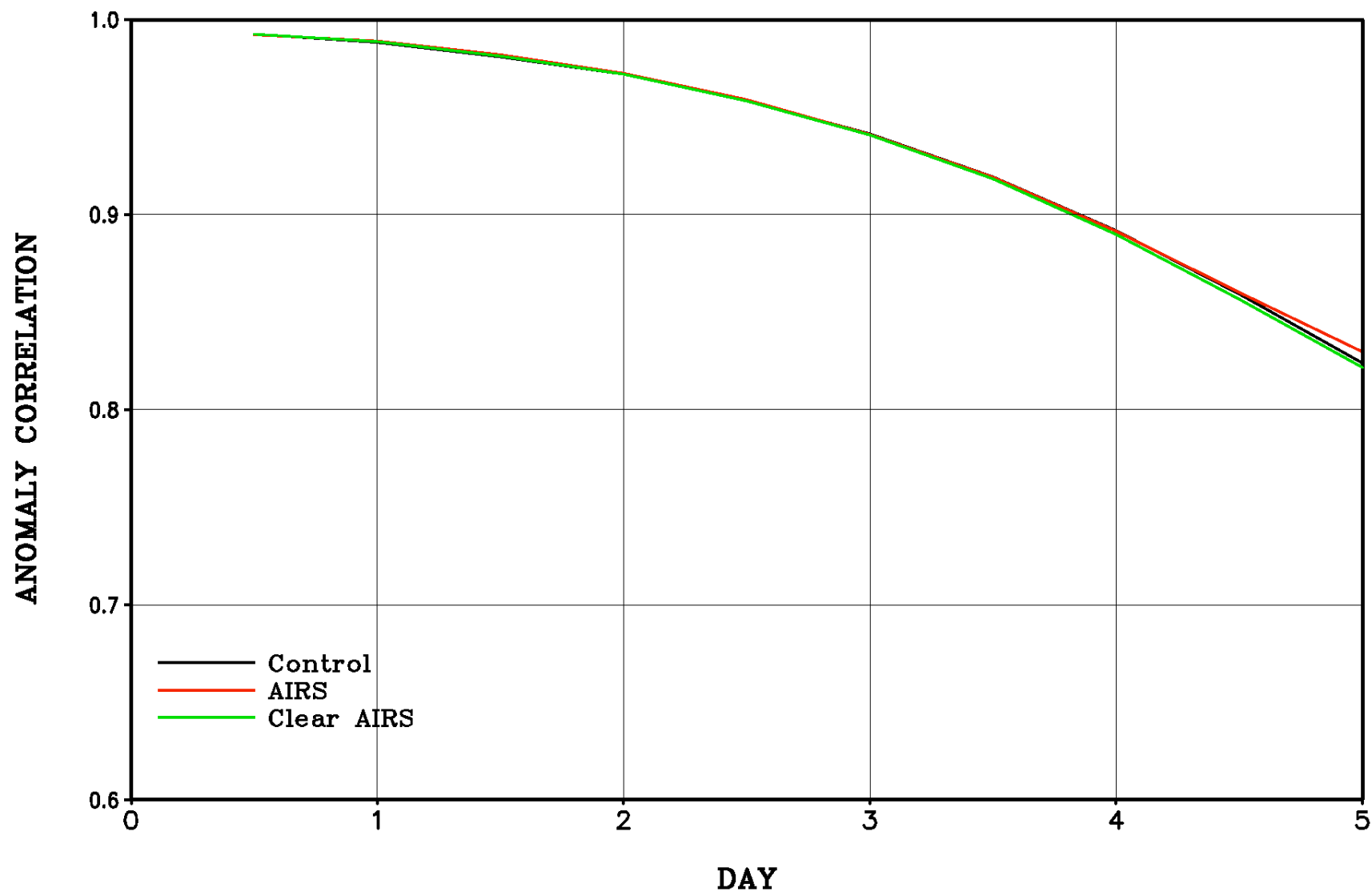


# Impact of AIRS on fvSSI Forecasts

Average of 26 Five-Day Forecasts

## 500 MB GEOPOTENTIAL HEIGHTS

Northern Hemisphere



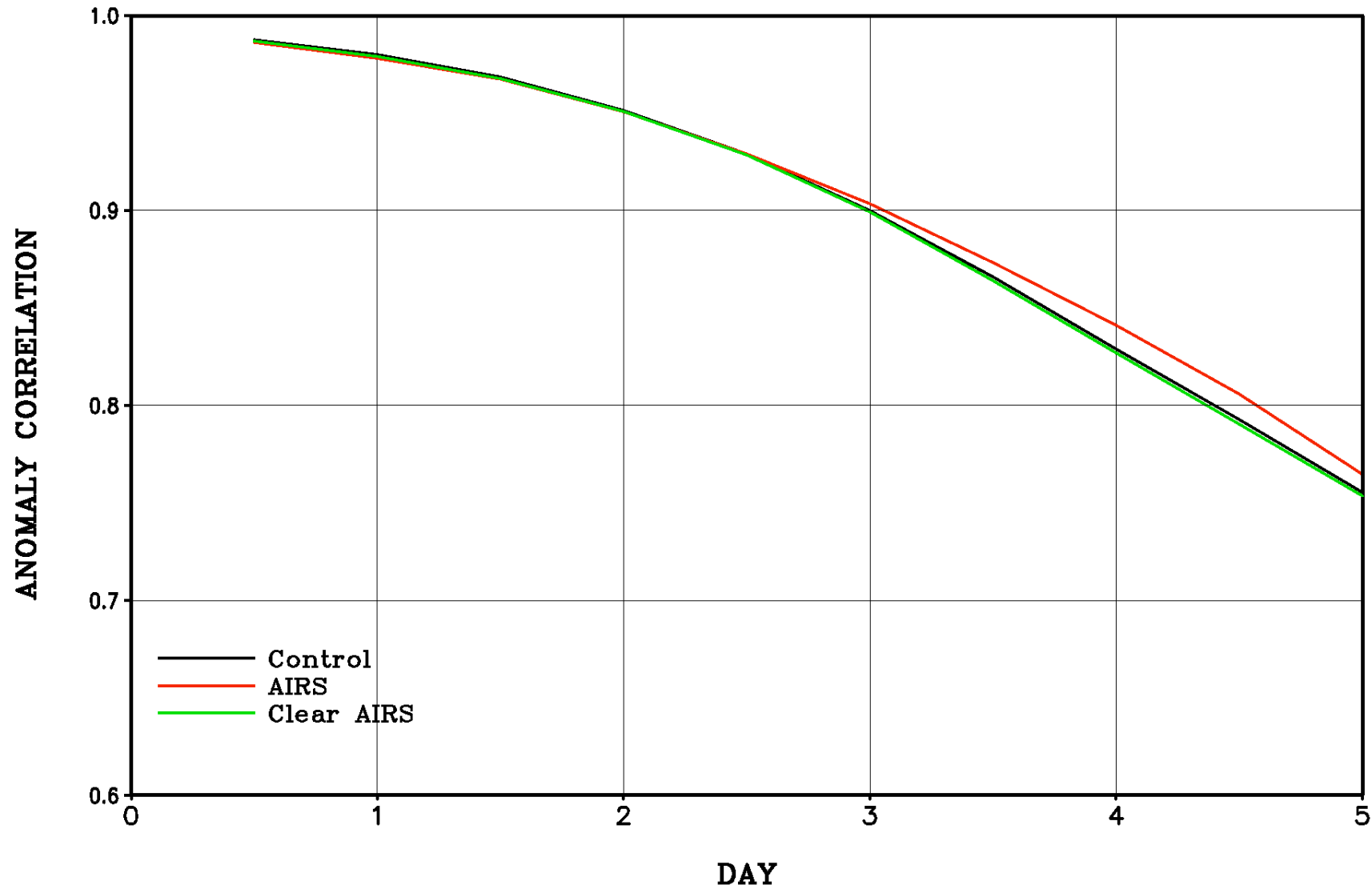
fv15+1 ctrl vs ncep  
fv15+2 vs acep  
fv15+3 vs acep

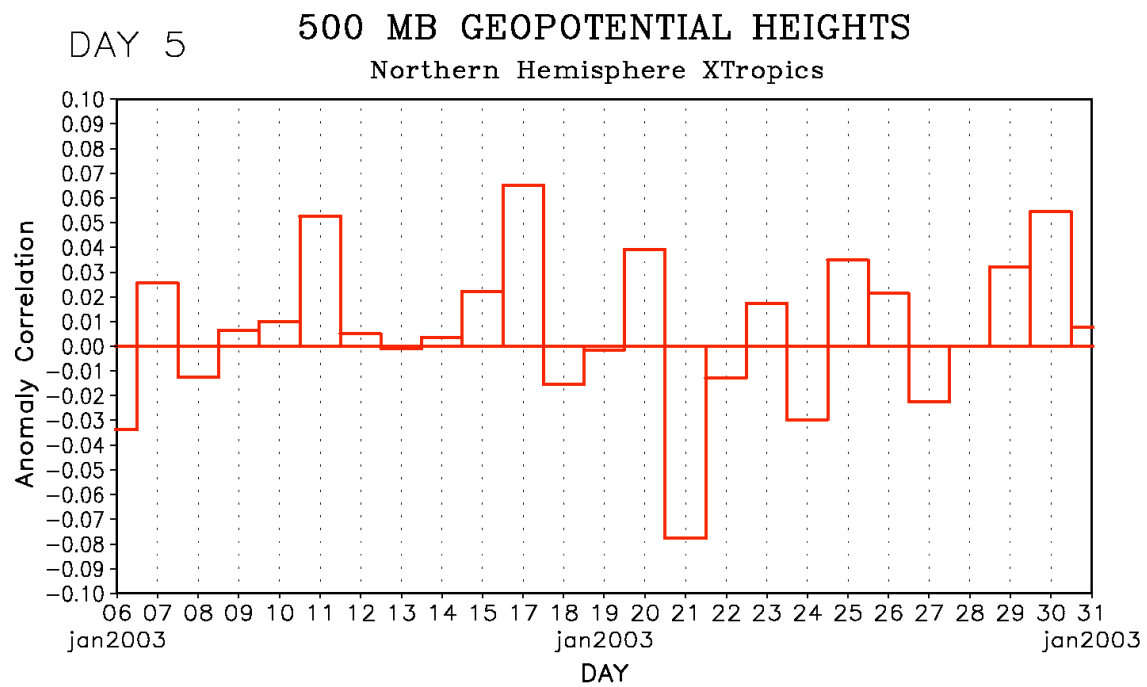
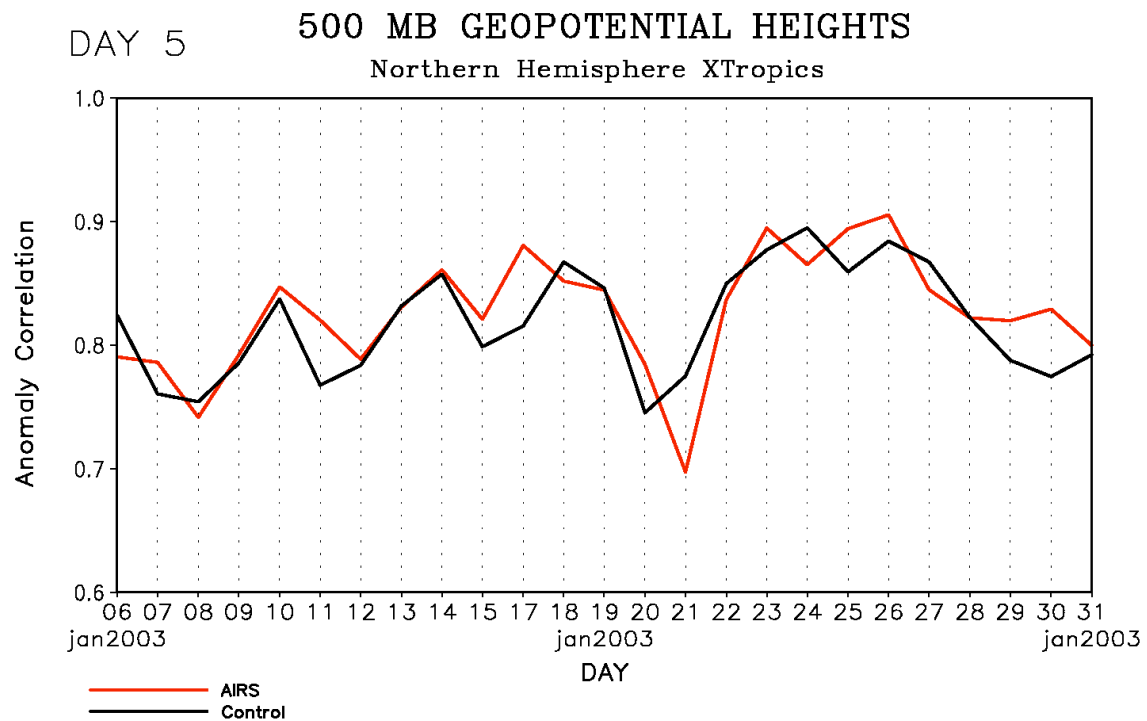
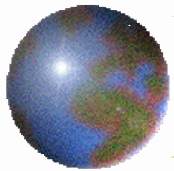
# Impact of AIRS on fvSSI Forecasts

Average of 26 Five-Day Forecasts

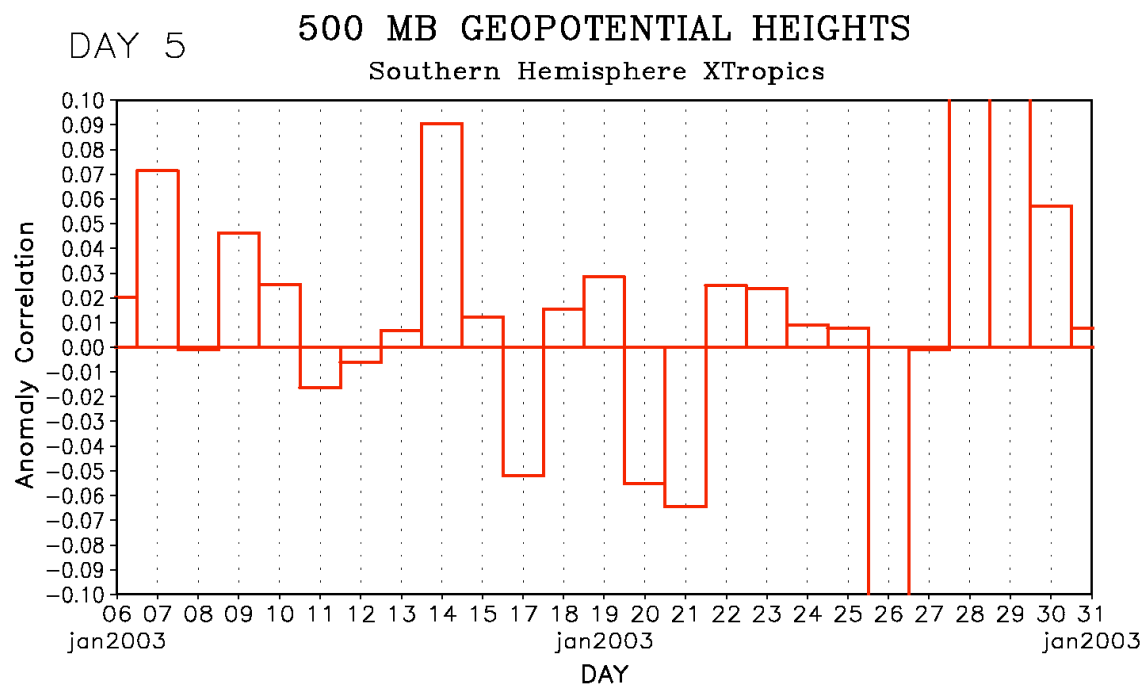
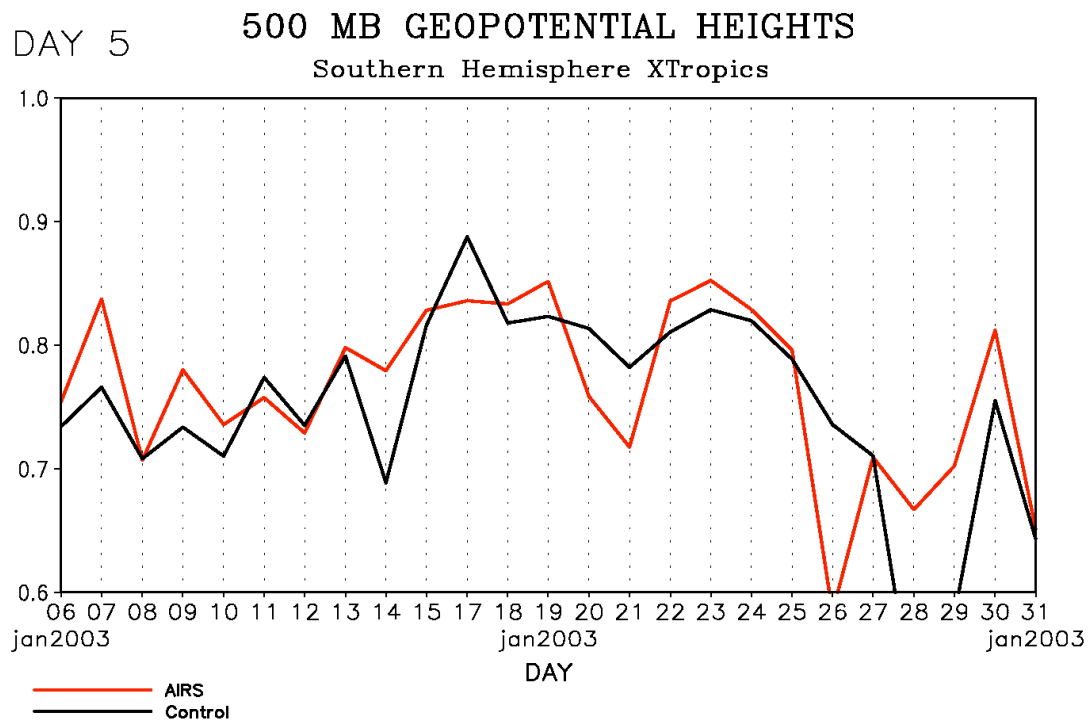
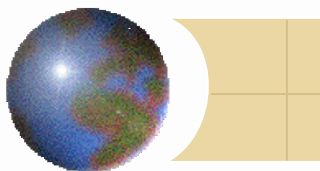
## 500 MB GEOPOTENTIAL HEIGHTS

Southern Hemisphere



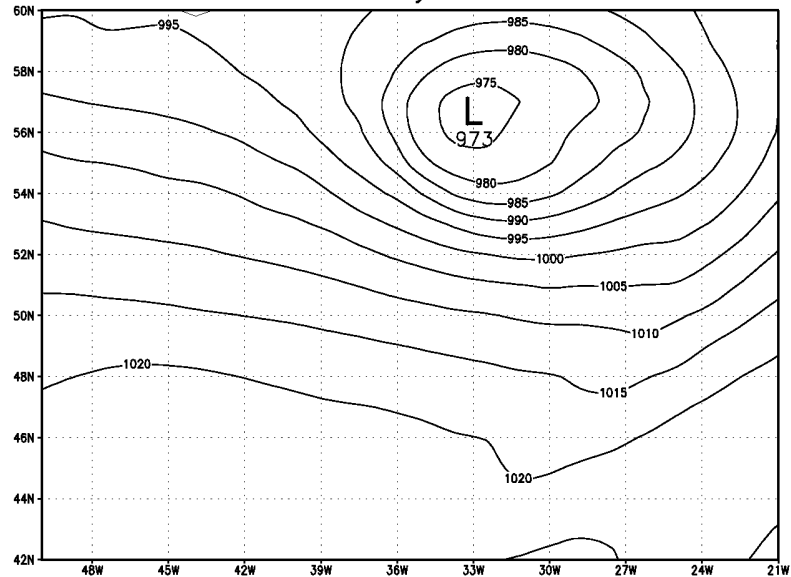






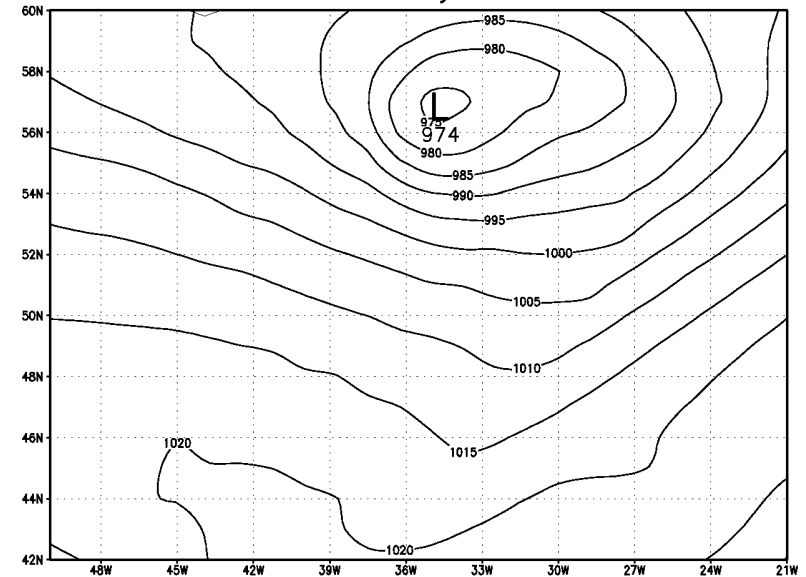
# COMPARISON: "CLEAR" AND "PARTLY-CLOUDY" AIRS FOR A 5-DAY FORECAST OF A CYCLONE AND TROUGH IN THE NORTH ATLANTIC

CONTROL 5-day SLP-forecast



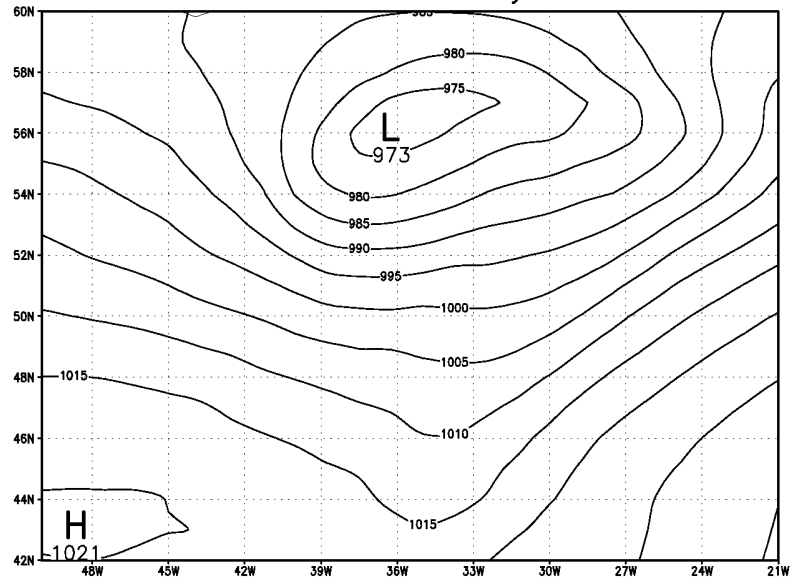
JAN 16 2003 00Z

AIRS CLEAR 5-day SLP-forecast



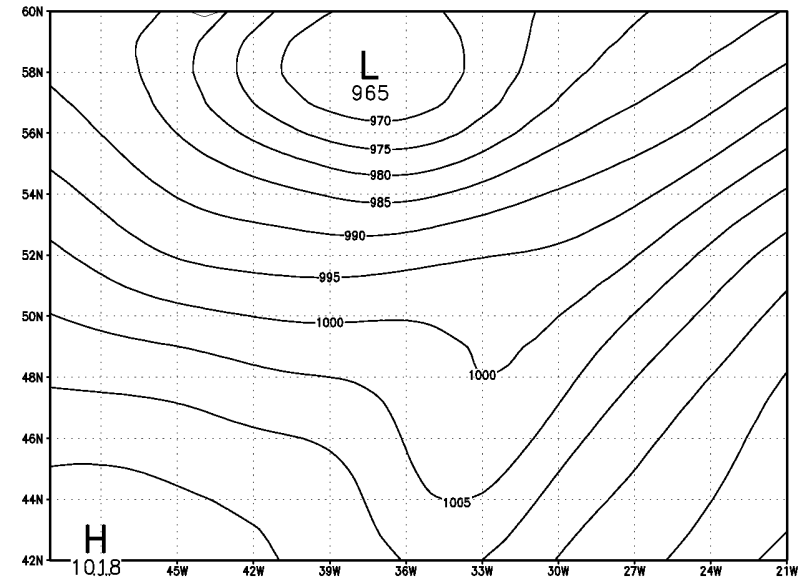
JAN 16 2003 00Z

AIRS PARTIALLY-CLOUDY 5-day SLP-forecast



JAN 16 2003 00Z

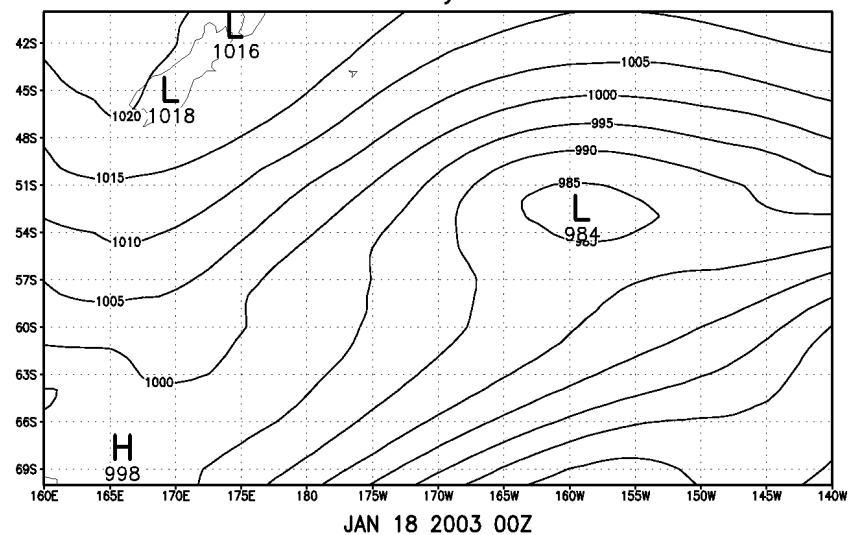
SLP-verification



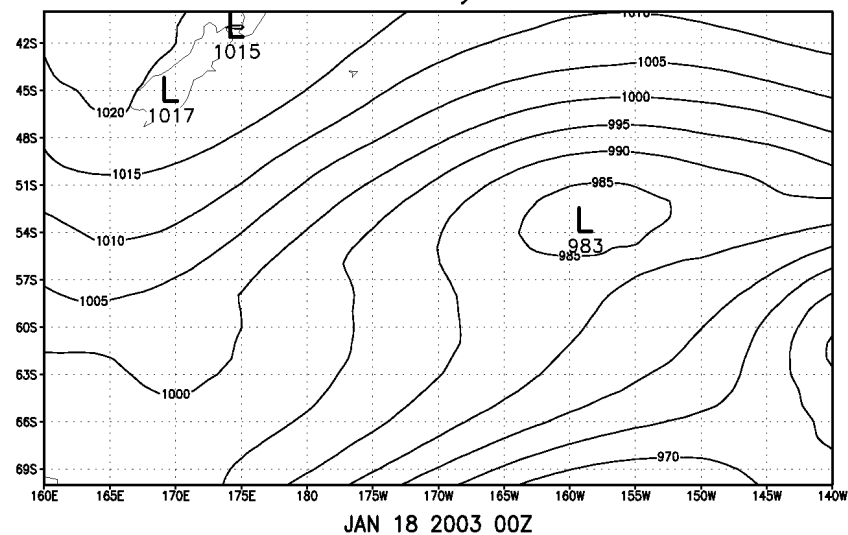
JAN 16 2003 00Z

# COMPARISON: "CLEAR" AND "PARTLY-CLOUDY" AIRS FOR A 4-DAY FORECAST OF A CYCLONE IN THE SOUTH PACIFIC

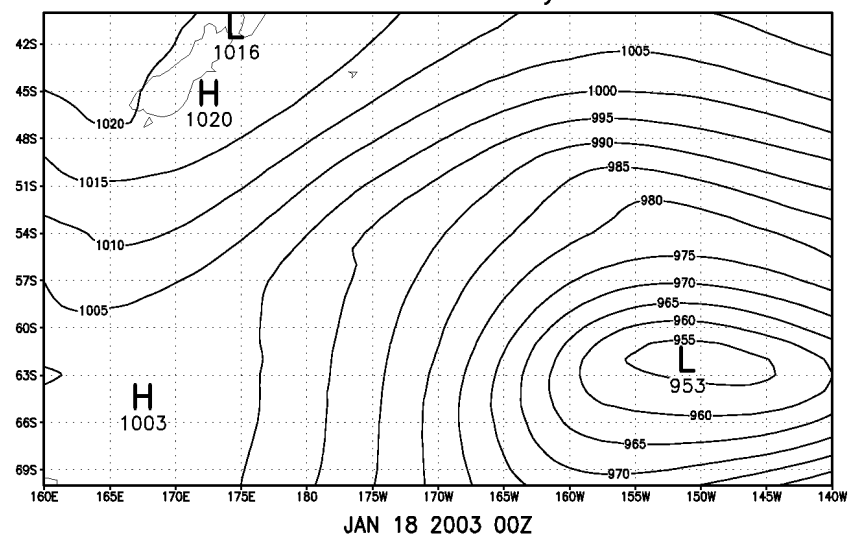
CONTROL 4-day SLP-forecast



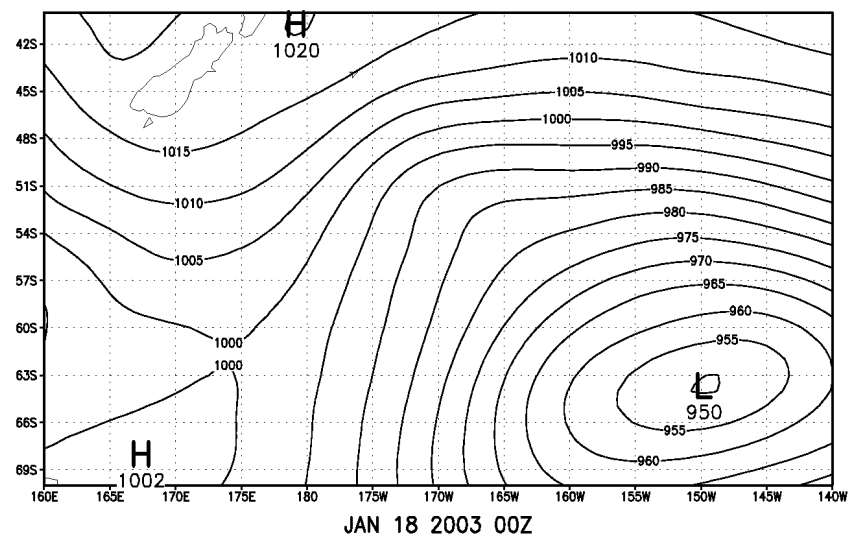
AIRS CLEAR 4-day SLP-forecast



AIRS PARTIALLY-CLOUDY 4-day SLP-forecast

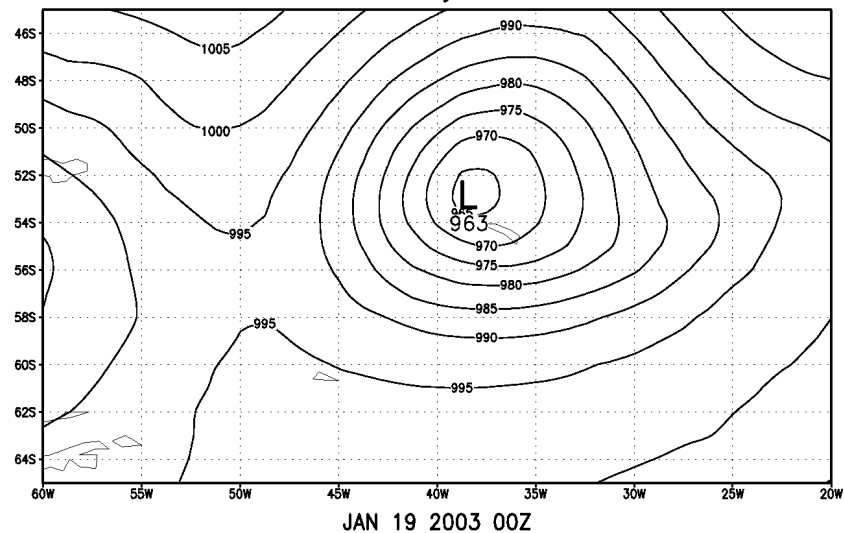


SLP-verification

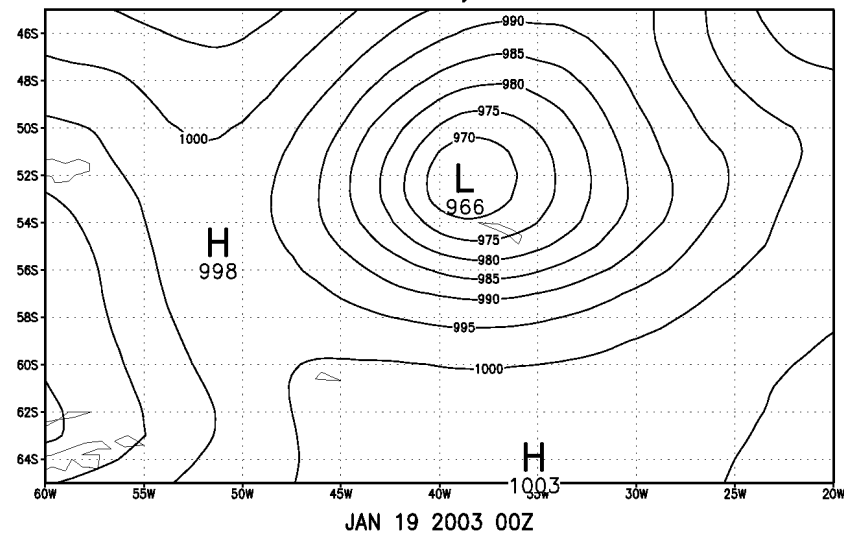


# COMPARISON: "CLEAR" AND "PARTLY-CLOUDY" AIRS FOR A 4-DAY FORECAST OF A CYCLONE IN THE SOUTH ATLANTIC

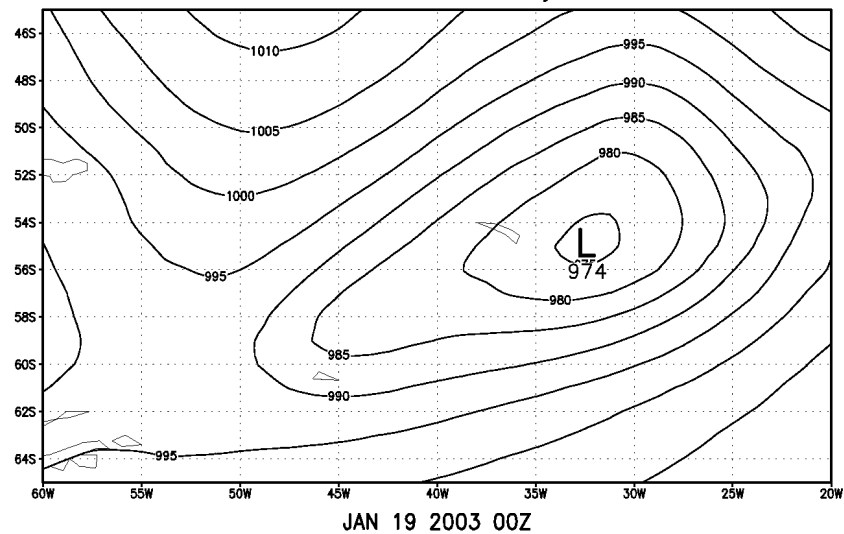
CONTROL 4-day SLP-forecast



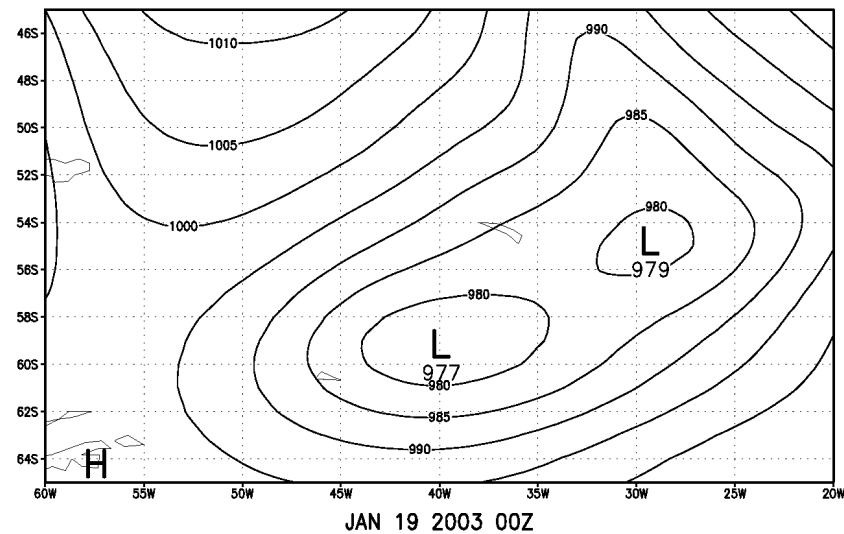
AIRS CLEAR 4-day SLP-forecast



AIRS PARTIALLY-CLOUDY 4-day SLP-forecast

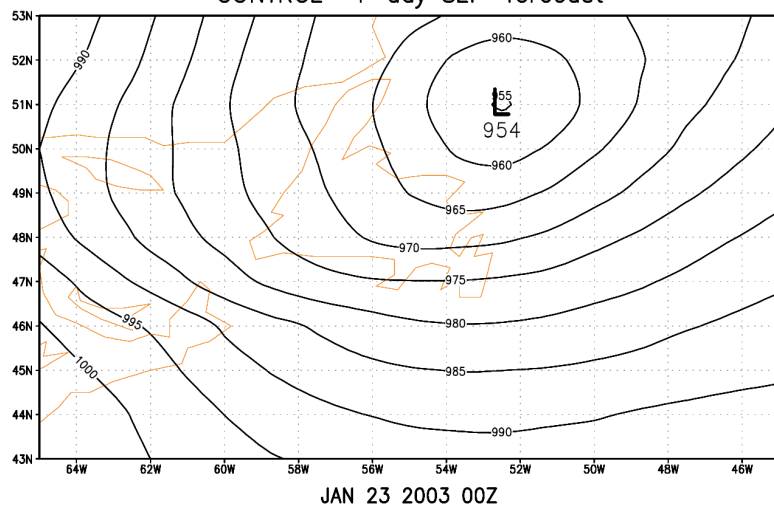


SLP-verification

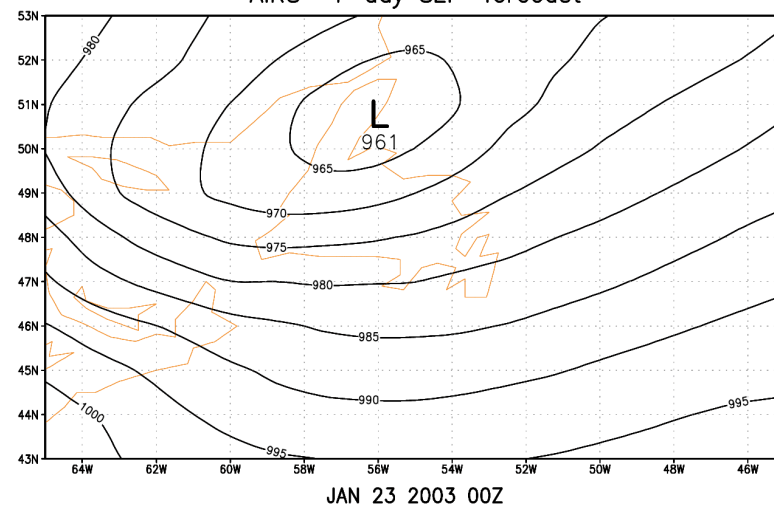


# IMPACT OF AIRS ON A 4-DAY FORECAST OF A CYCLONE NEAR NEW FOUNDLAND

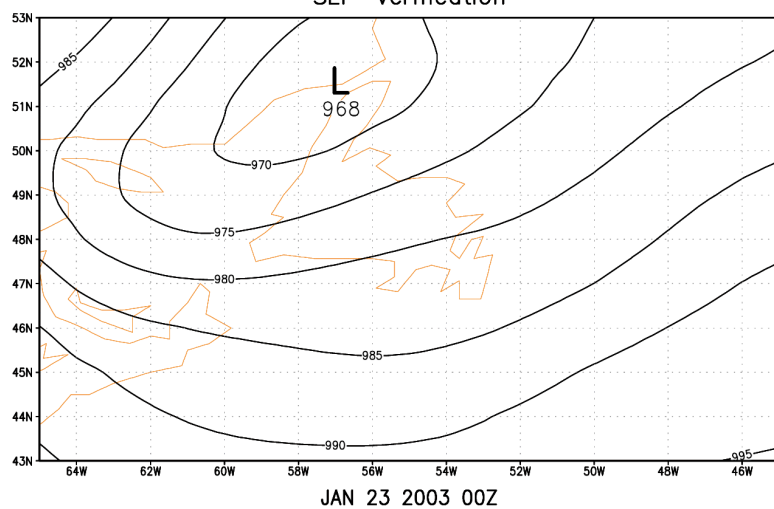
CONTROL 4-day SLP-forecast



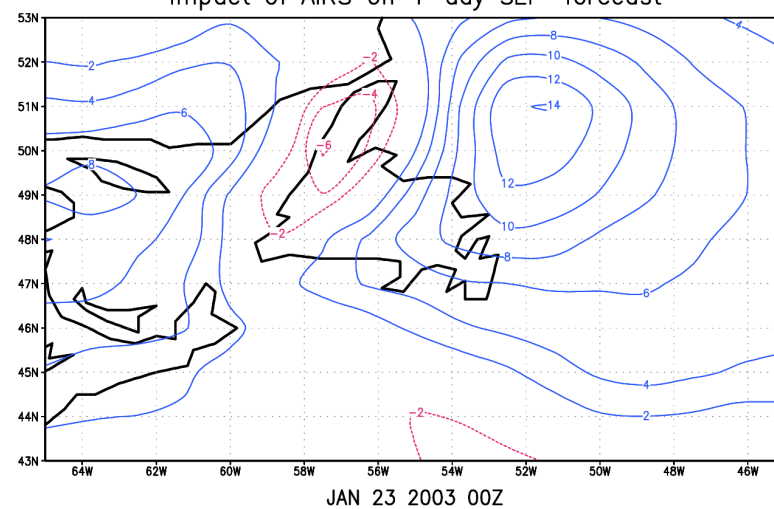
AIRS 4-day SLP-forecast

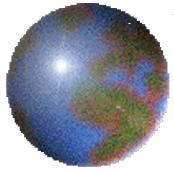


SLP-verification



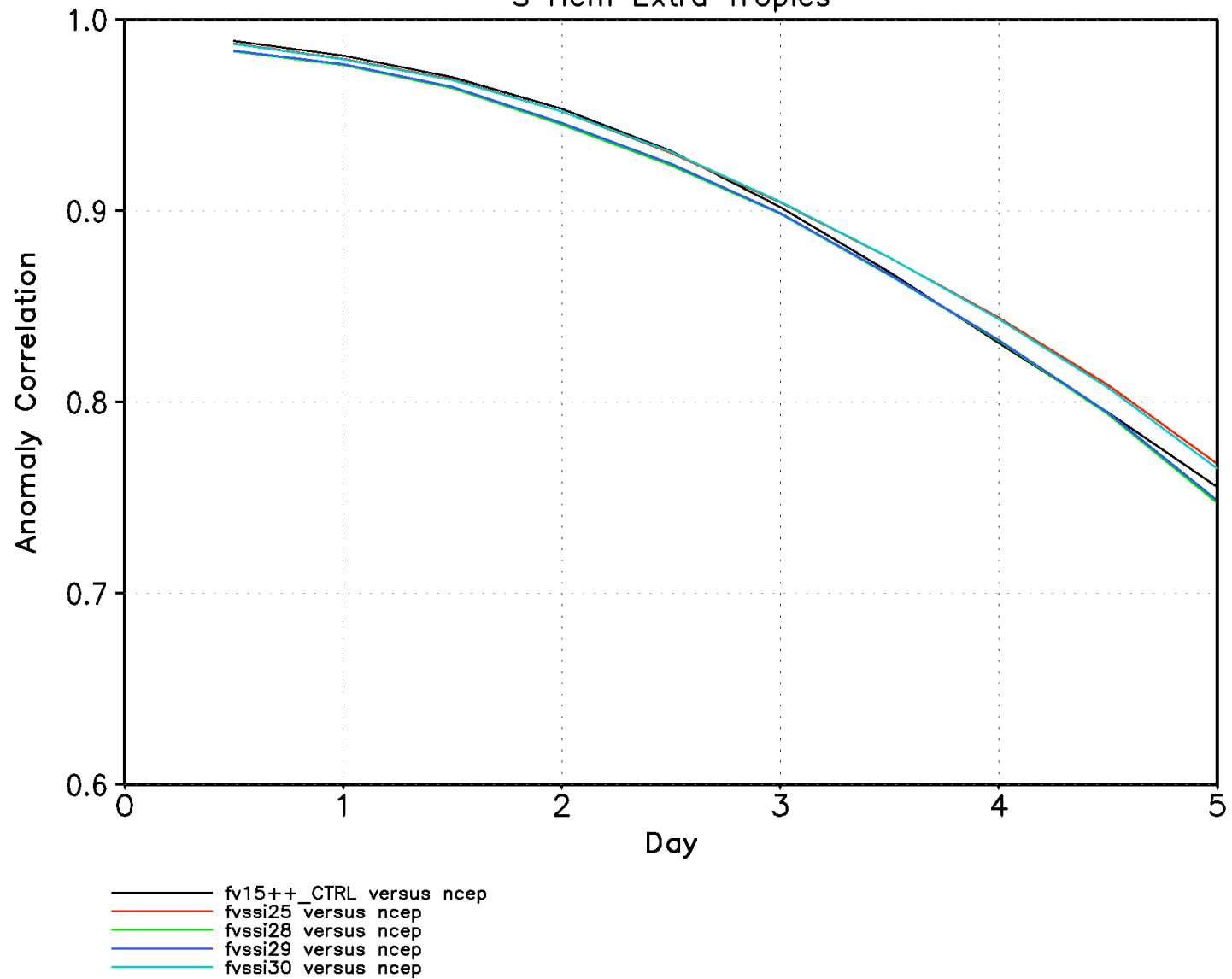
impact of AIRS on 4-day SLP-forecast

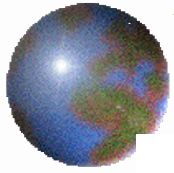




## Impact of Airs Moisture Profiles

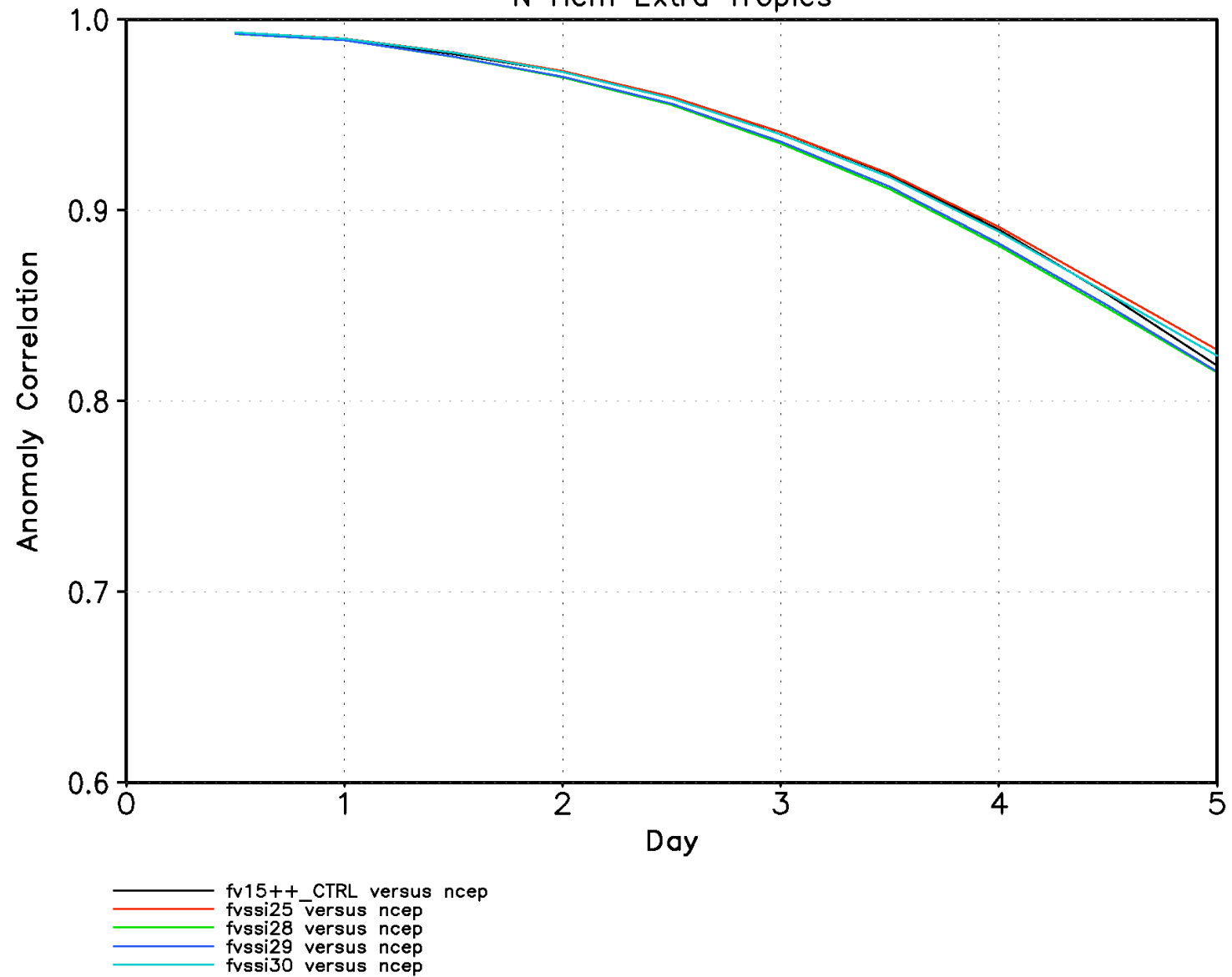
### 500mb Geopotential Heights S Hem Extra Tropics



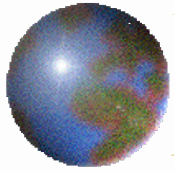


## Impact of Airs Moisture Profiles

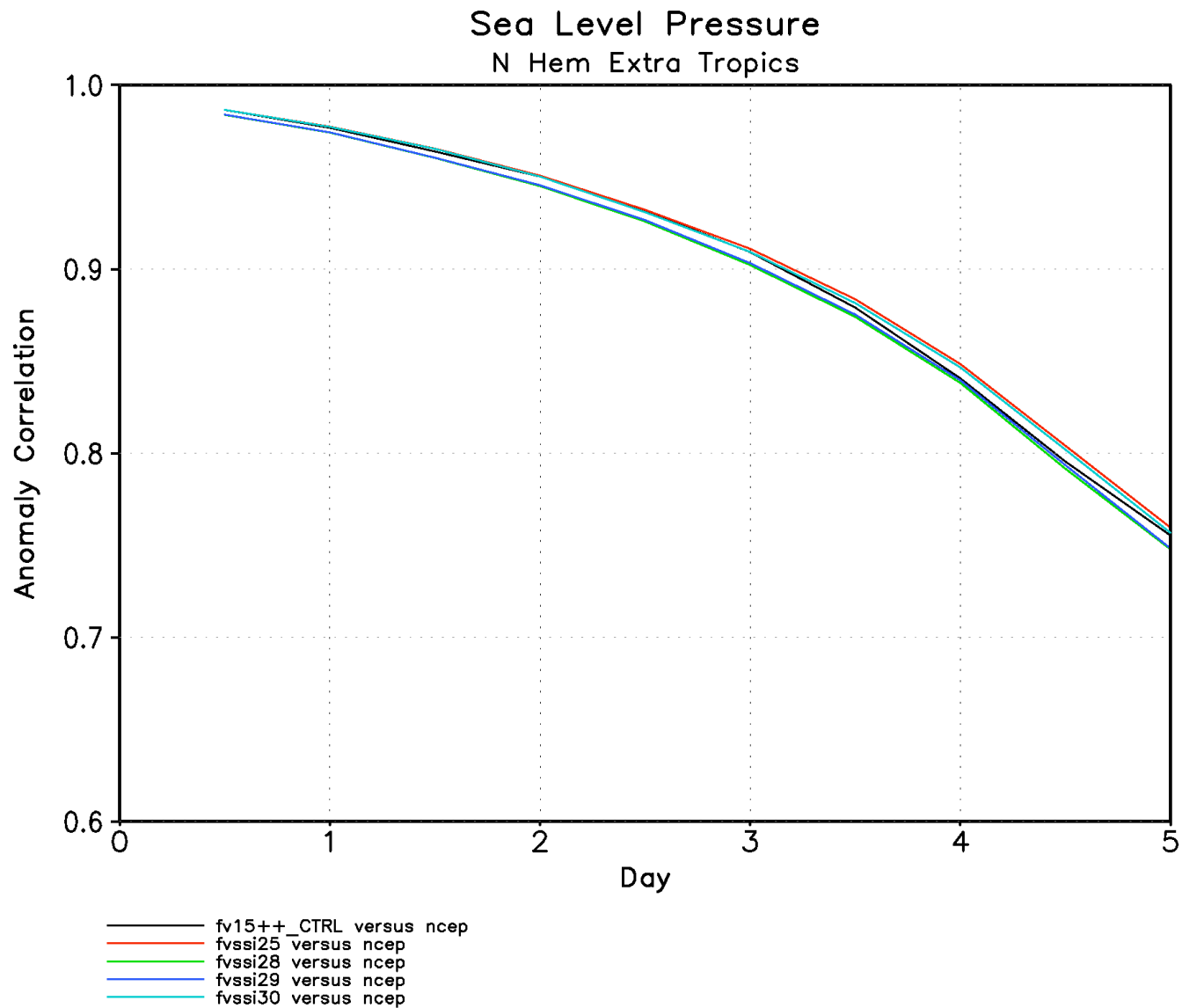
500mb Geopotential Heights  
N Hem Extra Tropics

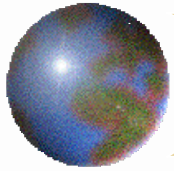




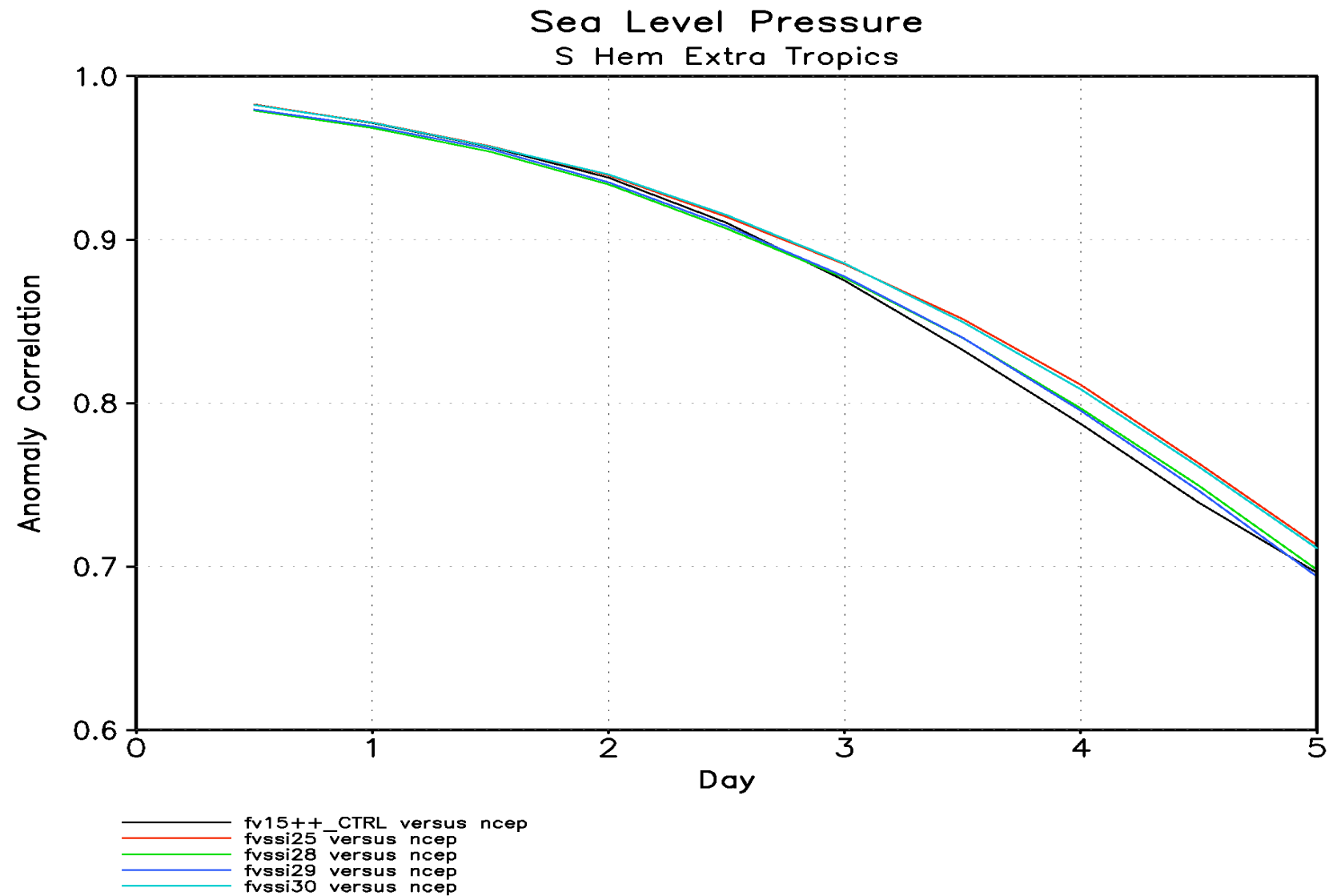


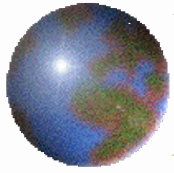
## Impact of Airs Moisture Profiles





## Impact of Airs Moisture Profiles





# *AIRS Experiments WITH FVSSI using AIRS radiance data (Joiner)*

## GLOBAL DATA ASSIMILATION SYSTEM USED:

fvSSI: fvGCM - Resolution: 1x1.25

SSI (NCEP) analysis-T62

PERIOD OF ASSIMILATION: 16 December, 2002 - 31 January, 2003

## EXPERIMENTS (ongoing) :

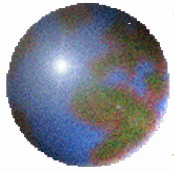
CONTROL: All Conventional Data + ATOVS + Radiance (NOAA-14, 15, 16)  
+ CTW + SSM/I TPW+ SSM/I Wind Speed + QuikScat + Ozone

CONTROL + AIRS radiance ( OPTRAN )standard weights, GSFC thinning

CONTROL + AIRS radiance ( OPTRAN )increased weights

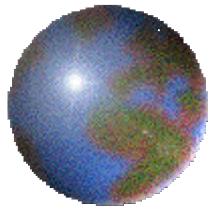
CONTROL + AIRS radiance ( OPTRAN ) + GSFC cloud screening

CONTROL + AIRS radiance ( OPTRAN ) + GSFC cloud clearing



## *Summary*

1. Assimilation experiments to assess the impact of AIRS retrievals using both the FVSSI and FVDAS data assimilation systems have been conducted.
2. In the Southern Hemisphere, there is a significant impact of AIRS temperatures on both analyses and forecasts. In the Northern Hemisphere, the impact is smaller, but still positive. Significant impacts on cyclone position, intensity and structure occur. Partially cloudy data contributes strongly to the impact obtained.
3. The initial impact of AIRS moisture retrievals is somewhat negative.
4. Ongoing and near future work include: evaluating the latest release of AIRS Team retrievals, comparing radiance and retrieval assimilation, and case studies to better understand and to improve the impact obtained.



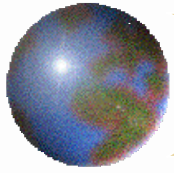
# *A case study of the impact of AIRS temperature retrievals on numerical weather prediction*

Oreste Reale<sup>(1)</sup>, Robert Atlas and Juan C. Jusem<sup>(2)</sup>

NASA GSFC Laboratory for Atmospheres

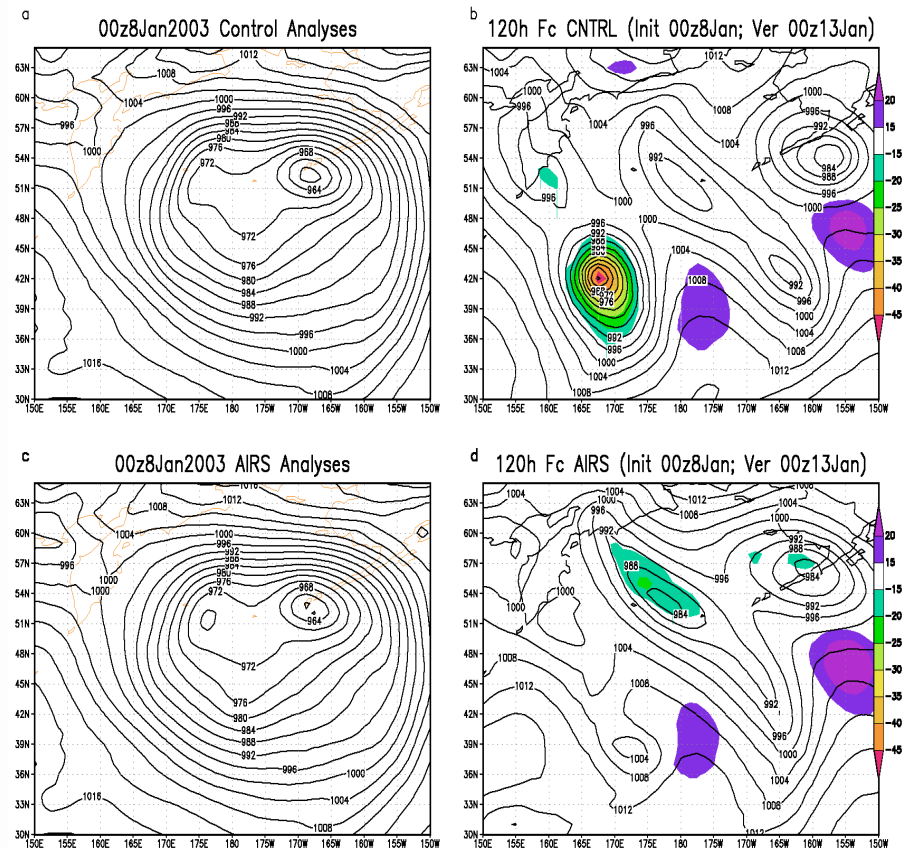
(1) Additional Affiliation: UMBC/GEST

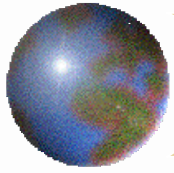
(2) Additional Affiliation: SAIC



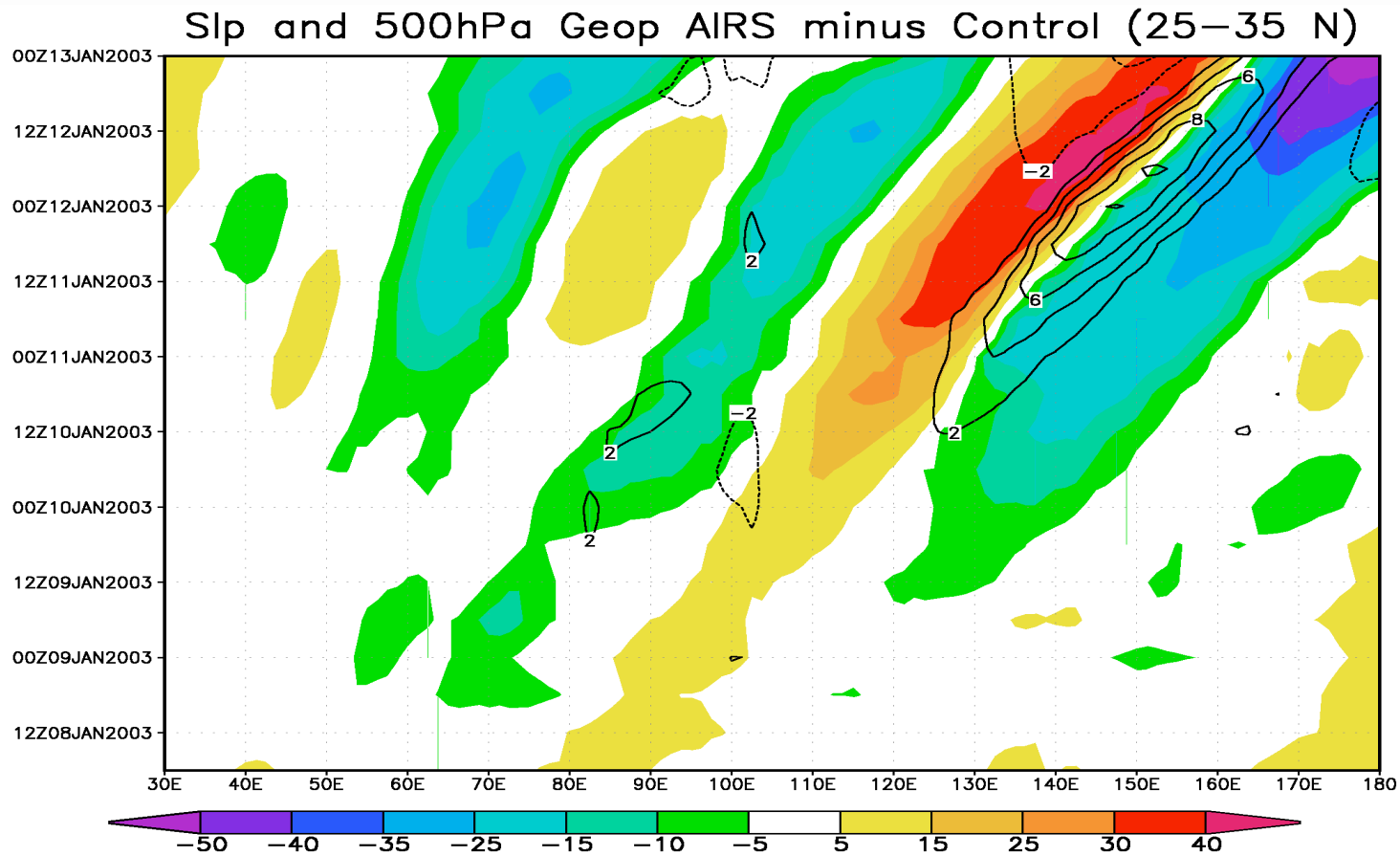
# *Explosive spurious cyclogenesis*

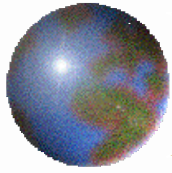
- ✚ The assimilation of AIRS temperature retrievals eliminates a spurious explosive cyclone over the NW Pacific.



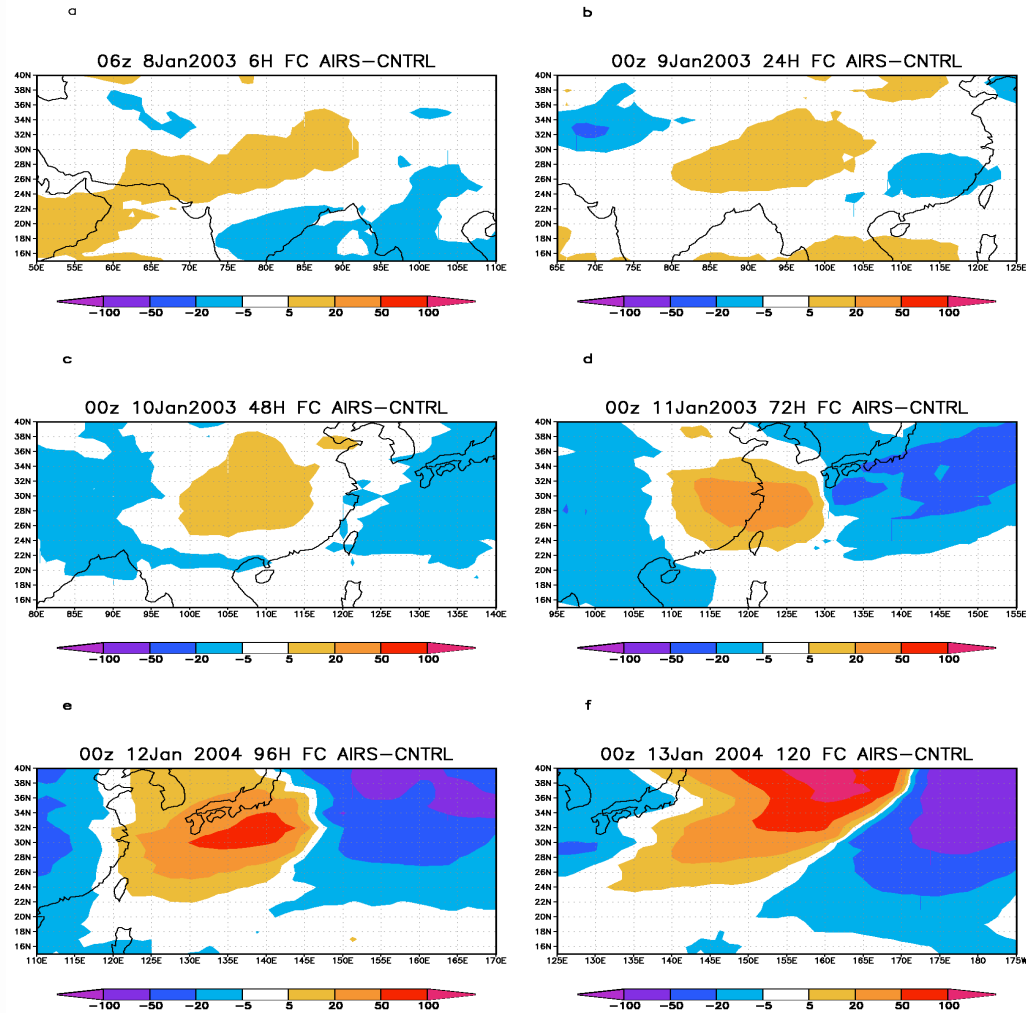


## *Hovm Diagram of AIRS-CNTRL 500hPa height and slp anomalies*

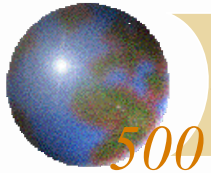




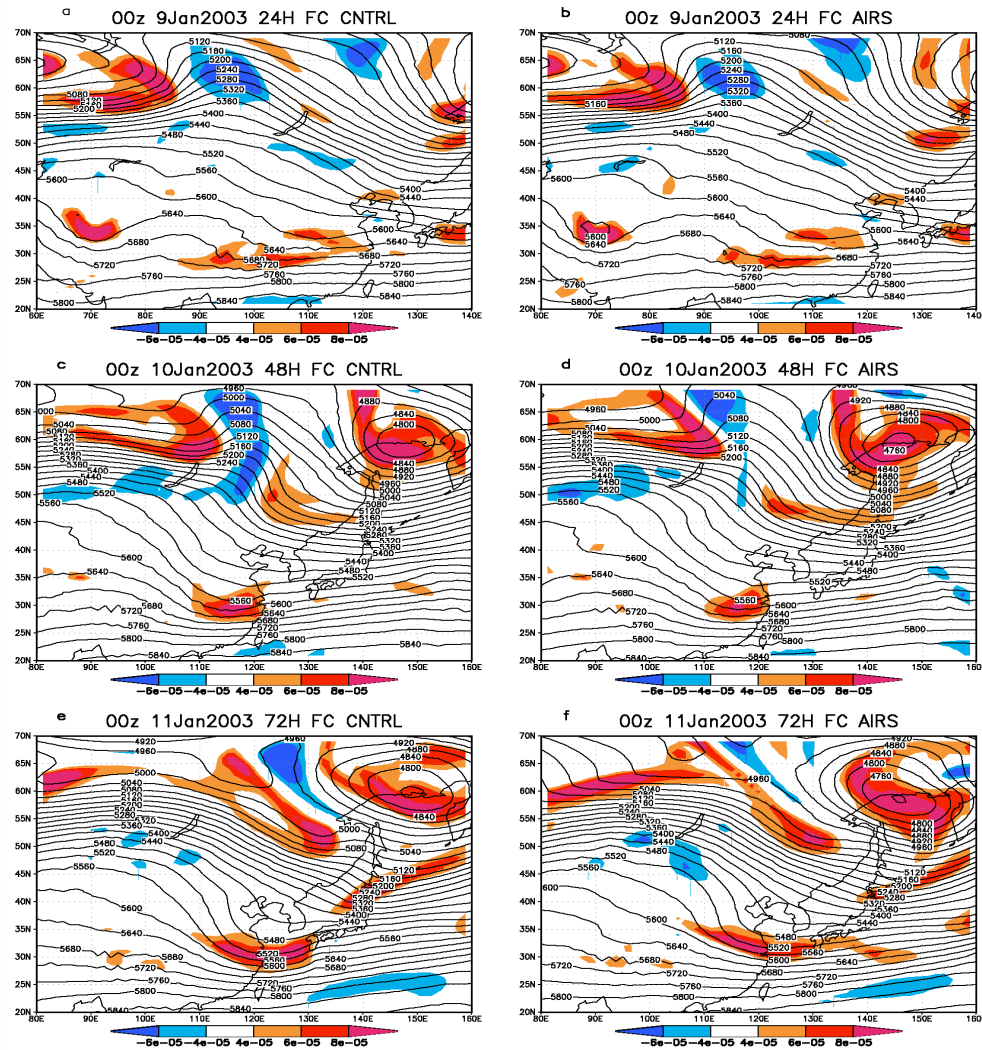
## 500hPa Height Anom





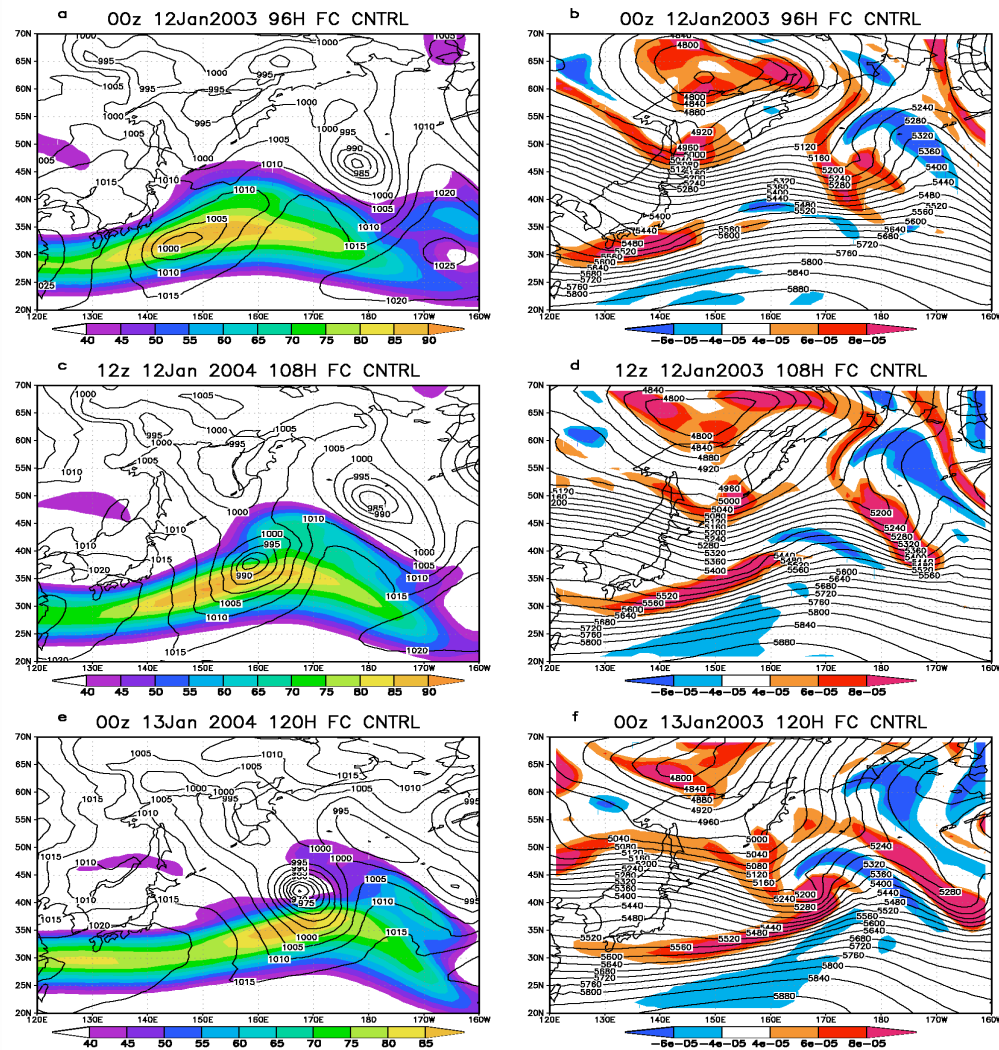


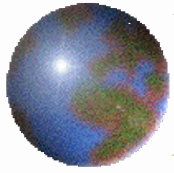
## 500 hPa Height and rel. vorticity





# *Slp, 250 Wind Speed, 500hPa Height and rel. vorticity (CNTRL)*





## *Slp, 250 Wind Speed, 500 hPa Height and rel. vorticity (AIRS)*

